MALONE SERVICE COMPANY SUPERFUND SITE
Texas City, Texas

CONSTRUCTION QUALITY ASSURANCE PLAN

Prepared for:
Malone Cooperating Parties

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TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

List of Attachments

LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Asbestos Containing Materials
API	American Petroleum Institute
ASTM	American Society for Testing of Materials
CD	Consent Decree
CD/SOW	Consent Decree/Statement of Work
CQA	Construction Quality Assurance
CQAP	Construction Quality Assurance Plan
CY	Cubic Yards
DOT	Department of Transportation
DQO	Data Quality Objective
ENTACT	ENTACT Services, LLC
GCL	Geosynthetic Clay Liner
HDPE	High Density Polyethylene
IQAT	Independent Quality Assurance Team
LBP	Lead Based Paint
LLDPE	Liner Low Density Polyethylene
MCP	Malone Cooperating Parties
MSC	Malone Service Company
PCB	Polychlorinated Biphenyl
PNL	Project Navigator, Ltd.
PM	Project Manager
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
QMT	Quality Management Team
RA	Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RD/RA	Remedial Design/Remedial Action
ROD	Record of Decision
RPM	Remedial Project Manager
SAP	Sampling Analysis Plan
SOW	Statement of Work
SS	Solidification/Stabilization
TCEQ	Texas Commission on Environmental Quality
UCS	Unconfined Compressive Strength
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

ENTACT has prepared this Construction Quality Assurance Plan (CQAP) in accordance the July 13, 2012 Consent Decree (CD) Statement of Work (SOW) between the U.S. Environmental Protection Agency (USEPA) and the Malone Cooperating Parties (MCP) (United States of America and State of Texas v. Alcoa, Inc., et al.; CA No. 3:12-cv-00210). Consistent with the CD/SOW, this Plan provides a detailed plan of how the Supervising Contractor will implement quality assurance and quality control (QA/QC) activities during construction activities associated with the Remedial Design/Remedial Action (RD/RA) at the Malone Service Company Superfund Site (Site) (CERCLIS ID# TXD980864789) in Texas City, Galveston County, Texas.

This CQAP provides the testing procedures, protocol and guidance for ensuring that the completed RD/RA at the Site meets or exceeds all design criteria and specifications and Performance Standards. The Performance Standards shall include the standards set forth in the Record of Decision (ROD), the CD/SOW, and as developed as part of the pre-design and approved by USEPA during the remedial work.

The CQAP is presented as a Component Plan to the General RD/RA Work Plan, along with the Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP), and provides the site-specific components of the quality assurance program that will ensure the construction of the completed project meets the requirements of the design specifications and the phased RD/RA Work Plans related to the solidification of sludge, compaction requirements, grading activities, erosion and sediment control, surveying, and cover placement.

1.1 Scope of the CQAP

This CQAP establishes the objectives and framework for the implementation of QA/QC activities for all construction activities at the Site. The RD/RA at the Site is being conducted in phases, and includes the work outlined below.

Phase One

- Pre-Design Investigations – Work Plan and Implementation
    - Slurry Wall Investigation
    - Sludge Pond Investigation
    - RCRA Cell Investigation
    - Building and Tank Investigation
    - Additional Data Collection (if required)
- Cemetery Relocation - Work Plan and Implementation
- Treatability Pilot Study - Work Plan and Implementation
- Above Ground Tank and Building Demolition

Phase Two

- Design and Construction of Slurry Wall (To be Completed During the Phase One RA)
- Design and Construction of Sludge Pond Berm Improvements
- Design and Construction of the RCRA Cell
- Sludge Treatment and Consolidation
- Soil Delineation, Excavation and Consolidation
- Confirmation of procedure used to abandon former injection wells
- Well logging and proper abandonment of groundwater monitoring wells, injection well WDW-73 and the proper plugging, logging and abandonment of the onsite water supply well to permit construction of the RCRA landfill.

Phase Three

- Site grading, drainage, and revegetation
- Confirmation of procedure used to abandon former injection well
- Well logging and proper abandonment of on-site hazardous waste injection well WDW-138
- Groundwater Monitoring Work Plan and Well Installation
- Institutional Controls

It should be noted that the Cemetery Relocation is being conducted separately from this RD/RA and EPA has previously reviewed and approved the Cemetery Relocation Work Plan (PNL, 2011).

Each Phase will include a Phase-specific RD/RA Work Plan. The RD/RA Work Plan for each phase will include the detailed construction quality assurance inspection requirements for each phase, including Phase-specific inspection forms, inspection test frequency, testing methodology, acceptance criteria, and reporting requirements. The scope of this draft CQAP includes a general discussion of the QA/QC work anticipated during RA activities and the anticipated QA/QC requirements related to major work activities. These QA/QC requirements will be refined and detailed in the RD/RA Work Plan for each phase. Please see Appendices A and B for examples of the documentation that will be included in each Phase RD/RA Work Plan.

In order to minimize cross-references and repetition, specific sampling activities are described in the following associated attachments of the General RD/RA Work Plan:

- Sampling procedures for wastes, soils, water and stabilized material – Sampling and Analysis Plan (Appendix F)
- Ambient air monitoring –Air Monitoring Plan (Appendix C)
- Air sampling for worker safety – Health and Safety Plan (Appendix B)

2.0 PROJECT RESPONSIBILITY AND AUTHORITY

ENTACT, LLC (ENTACT) project personnel will be responsible for the quality of construction in the finished product and for compliance with the construction documents, drawings and specifications, and regulatory requirements. The ENTACT Project Manager has the overall responsibility for ensuring that all construction activities are performed in a manner consistent with the approved plans, construction drawings, specifications, and quality assurance requirements. ENTACT's Quality Management Team (QMT) will assist the Project Manager in implementing this CQAP. Additionally, ENSAFE has been selected to be an Independent Quality Assurance Team (IQAT) intended to provide additional independent quality assurance oversight during remedial action activities. A project organization chart is provided in Attachment 1, with QMT members highlighted. Their qualifications and experience are provided in Attachment 2.

2.1 USEPA Remedial Project Manager

The USEPA Remedial Project Manager (RPM) for the Site is Mr. David Abshire as listed in Section XXVII of the CD. The RPM is the USEPA's representative for oversight and management of all activities associated with the performance of the approved remedy. The RPM has the overall responsibility for the oversight of all phases of the project.

2.2 TCEQ Project Manager

The Texas Commission for Environmental Quality (TCEQ) Project Manager (PM) is Ms. Marilyn Czimer Long, P.G. The TCEQ PM will ensure that remedial activities comply with state requirements, where applicable.

2.3 MCP Project Manager

The MCP Project Coordinator is Robert Piniewski of Project Navigator, Ltd., who will monitor and oversee all phases of the RD/RA work and will provide reports to the USEPA RPM and TCEQ PM. The responsibilities of the Project Coordinator will also include resolving issues concerning compliance with the CD, providing the USEPA with the required notifications, providing status reports of the progress of remedial activities to the USEPA, updating the project implementation schedule, resolving regulatory issues with the USEPA, and contract administration.

2.4 ENTACT - Supervising Contractor

ENTACT, as the Supervising Contractor, will be responsible for the construction and implementation of the remedy set forth in the CD/SOW for the Site and the RD/RA Work Plan. The Remedial Design/Remedial Action Team consists of highly experienced professionals and engineers with areas of expertise in each of the major components of the approved remedy. The key team members assigned to perform the key duties critical to achieving the remedial action goals and data quality objectives (DQOs) are described below

2.4.1 ENTACT Project Director

The ENTACT Project Director and Executive in Charge will be Mr. Greg Tunstall, P.E. who is the President and Chief Operating Officer for ENTACT. He has led the completion of multiple RD/RA projects involving solidification/stabilization (SS) of mixed organic wastes, slurry wall installations, and construction of Resource Conservation and Recovery Act (RCRA) equivalent cells and caps. He will have the overall responsibility for ensuring that the entire project is implemented and completed in accordance with the requirements of the CD/SOW, the 100% design specifications, when completed, the RD/RA Work Plan, and applicable federal, state, and local regulations. Mr. Tunstall will be the main point of contact for the MCP Project Coordinator and/or the EPA RPM and TCEQ PM.

2.4.2 ENTACT Corporate Health and Safety Officer

The ENTACT Corporate Health and Safety Officer will be Mr. Warren Houseman. The Corporate Health and Safety Officer will be responsible for writing and reviewing the site-specific Health and Safety Plan and overseeing ENTACT's Health and Safety Program. He will provide direction to the ENTACT Project Manager and/or On-site Health and Safety Officer, as necessary, on issues of health and safety. The Corporate Health and Safety Officer will be responsible for conducting the Health and Safety Orientation Meeting prior to the start of construction activities, reviewing weekly health and safety updates and conducting health and safety inspections of the Site during the RA.

2.4.3 ENTACT RD Project Manager

The ENTACT RD Project Manager, Mr. Aiman Naguib, will manage the RD team, leading efforts and providing technical expertise and direction in the areas of engineering design, wastewater management and treatment, solid and hazardous waste management, air monitoring, backfill placement, cover system installation, and any other technical design requirements for the RA.

Mr. Naguib has over twenty years of experience in general remediation, specialty environmental, and geotechnical construction. He has worked extensively as a technical advisor and project manager on complex geotechnical projects involving slurry wall, and cap design and construction. Moreover, Mr. Naguib has particularly extensive and specialized expertise in the area of solidification and stabilization.

2.4.4 ENTACT RA Project Manager

The ENTACT RA Project Manager, Mr. Erik Gehringer, brings over 16 years of experience in the environmental and construction industries, and will provide critical input and constructability support throughout the Remedial Design to ensure that the most efficient approach is crafted for this project. Mr. Gehringer will also lead the RA team's efforts in the field. As a Project Manager at ENTACT, Mr. Gehringer is responsible for all aspects of construction management including project engineering, scheduling, subcontractor coordination, contract administration, health and safety, procurement, estimating, field crew oversight/supervision, equipment operation, and customer communication.

The Project Manager will have the overall responsibility for project efforts including technical, schedule, and budget aspects. The Project Manager will communicate directly with the MCP Project Coordinator, and/or the EPA RPM and TCEQ PM. Specific responsibilities of the Project Manager will include interpreting and planning overall work efforts, approving work products, plans, and deliverables, defining resource needs and securing commitments resources, subcontract management, developing/reviewing schedules and budgets, and taking overall responsibility for the preparation and planning of work documents and field activities.

2.4.5 ENTACT Solidification Design Lead

Mr. Steve Liatti, P.E. will lead ENTACT's Solidification Design and will provide technical assistance to the ENTACT RA team during field construction, as well as performing on-site field engineering. He is a registered professional engineer with specific emphasis on SS and slurry wall construction projects.

2.4.6 ENTACT Engineer

Ms. Lin Liu, PhD, P.E., will provide engineering support to the design team and in setting up the overall geotechnical testing protocol for the RA. Ms. Liu's duties will include providing technical direction for the implementation of the required RA activities and for ensuring the required quality control testing is performed in accordance with the requirements of the approved General RD/RA Work Plan (including the general support plans) and the results are provided to ENTACT's project management team, the Project Coordinator, and the USEPA RPM. She will provide oversight and direction to the entire Quality Management Team and will provide assistance in the modification of technical requirements of the remedial activities, if different from technical requirements provided in the approved RD/RA Work Plans.

2.4.7 ENTACT Field Project Manager (Site Superintendent)

The ENTACT Site Superintendent will be Mr. Tom Zodrow who has hands-on experience managing remedial actions involving complex SS and soil mixing large volumes of impacted soils, sludges and wastes. As the Field Superintendent, he will be responsible for directing all site personnel, equipment, subcontractors, and in ensuring the work is conducted safely, in compliance with the 100% design specifications and RD/RA Work Plan and meets the project milestones and budgetary goals. He will report directly to the ENTACT RA Project Manager.

2.4.8 ENTACT Corporate QA/QC Manager

The ENTACT QA/QC Manager is Ms. Jennifer Alexander. The ENTACT QA/QC Manager will be responsible for ensuring that all ENTACT procedures for this project are being followed. She will provide direction to the ENTACT Superintendent and/or On-site Quality Control (QC) Officer, as necessary, on issues of health and safety. In addition, the ENTACT QA/QC Manager will be responsible for the validation of all data received from the analytical laboratory.

2.4.9 ENTACT On-Site QA/QC Manager

The ENTACT On-site QA/QC Manager is Lin Liu, PE, PhD, who will be responsible for performing all required quality control testing at the Site and will report directly to the ENTACT Corporate QA/QC Manager. The On-site QA/QC Manager will ensure all sampling protocol and requirements are followed during data collection and reporting and will have the authority to correct and implement additional measures to assure compliance with the approved RD/RA Work Plans. Specific responsibilities will include:

- Ensuring that required QA/QC procedures are properly implemented and documented;
- Ensuring adherence to the approved CQAP, SAP and QAPP;
- Coordinating the implementation of the CQAP with the PM and Field Project Manager;
- Documenting any deviations to the CQAP with a justification for the deviations, and, if necessary, appropriate notification in accordance with the approved RD/RA Work Plans;

- Securing necessary sampling tools, bottles, packaging/shipping supplies, chain-of custody documents, etc. in accordance with the approved RD/RA Work Plans;
- Collecting or directing the collection of samples for laboratory analysis of the parameters specified in the SAP and QAPP and activities detailed in the CQAP;
- Documenting the location, time, and date of all samples that are collected and shipped to the laboratory;
- Interfacing with site personnel so that the sample collection is coordinated with the general progression of work;
- Notifying the PM of any sampling activities associated with the implementation of the approved RD/RA Work Plans;
- Obtaining analytical results, evaluating laboratory and field geotechnical data, and reporting the data to the PM;
- Approving or disapproving of materials supplied to the Site and procedures for installation and/or use of those materials.

2.4.10 ENTACT Field Technical Staff

The ENTACT Technical Staff for this project will be selected from our team of hazardous materials technicians. All of the designated team members are experienced professionals who possess the degree of technical competence required to effectively and efficiently perform the required work.

2.5 Independent Quality Assurance Team (IQAT)

EnSafe is the Independent Quality Assurance Team (IQAT) and will be responsible for verifying that the Quality Assurance Project Plan (QAPP), Construction Quality Assurance Plan (CQAP), and other key plans are properly implemented and in compliance with project specifications and standards. This will be accomplished by the IQAT performing independent, on-site observations, review of record-keeping reports, logs, and data, and interviews. Potential deviations of project specifications and standards will be communicated to the PNL Project Coordinator and the ENTACT RD and RA Project Managers, and the potential issues will be immediately discussed and resolved. General items noted by the IQAT will be documented in the weekly meetings and the monthly reports, as well as quarterly IQAT reports to the MCP, EPA, and TCEQ.

The IQAT will also participate in the work plan development phase including review of plans and specifications, such as the RD Work Plan, QAPP, CQAP, SAP, Design Plans and other plans as necessary. The IQAT will also attend key construction inspections (Prefinal and Final) to document final site conditions.

The on-site presence of the IQAT is anticipated to include 4 to 8 days monthly, with more frequent site visits as necessary during busy field construction periods, key construction milestones, and Prefinal and Final inspections.

2.5.1 EnSafe IQAT Senior Project Manager

The EnSafe IQAT Senior Project Manager will be Jay Spence, P.G. He has over 24 years of relevant

engineering, site investigation, remediation, and construction project experience in Texas and within EPA Region 6. He has served as a Project Manager and Quality Control Manager for similar remedial construction projects in Texas and will serve as Senior Project Manager and backup Quality Assurance Field Manager for the MSC site.

2.5.2 EnSafe IQAT Field Quality Assurance Manager

The EnSafe IQAT Field Quality Assurance Manager will be Les Cole, P.G. He has over 25 years of relevant engineering, site investigation, remediation, and construction experience in Texas, within EPA Region 6, and nationwide. He has served as Project Quality Control Officer on similar remedial construction projects in Texas, including a former lead smelter demolition and remediation in West Dallas and a residential removal action in South Dallas. He will serve as EnSafe's primary Quality Assurance Field Manager for the MSC Site.

2.6 Laboratory Management

Geotechnical and environmental samples collected from the Site will be tested at offsite laboratories that meet the USEPA requirements as listed in the CD. Geotechnical testing on materials listed in Table 2 include soil classification, proctors, UCS testing on stabilized material, and in-place density testing. Analytical testing as described on Table 1 of the QAPP will consist of confirmation testing, supplemental drum material testing, water sample testing, rinsate blank testing, and air monitoring media testing. These tables detail the specific testing procedures, frequencies, and test methods that will be required during the RA. These parameters will be finalized during the completion of the design and incorporated into each phased RD/RA Work Plan. The following subsections describe the personnel positions including lines of authority that will be involved in the laboratory testing of geotechnical and environmental samples from the Site

2.6.1 Laboratory Project Manager

The Laboratory Project Manager will report directly to the On-site QA/QC Manager and will be responsible for ensuring that all resources of the laboratory are available on an as-required basis. The Laboratory Project Manager will also be responsible for the review of final analytical reports and will oversee all geotechnical sampling activities including the selection of sampling locations, sample analysis and analysis of results. All data reports, QC reports, and other information generated from the laboratory will be provided to the On-site QA/QC Manager by the Laboratory Project Manager.

2.6.2 Laboratory QA Officer

The Laboratory QA Officer has the overall responsibility for data after testing and analysis is completed. The Laboratory QA Officer will communicate data issues through the Laboratory Project Manager. In addition, the Laboratory QA Officer will review laboratory QA/QC documentation, conduct detailed data reviews, determine whether to implement corrective action, and define appropriate laboratory procedures.

2.6.3 Laboratory Sample Custodian

The Laboratory Sample Custodian will be appointed by and supervised by the Laboratory Project Manager. The Laboratory Sample Custodian responsibilities will include the following: receiving, recording and inspecting incoming samples; verifying the accuracy of chain-of-custody records; notifying the Laboratory Project Manager of sample receipt and inspection details; assigning unique identification numbers to

incoming samples; entering the unique identification numbers of each sample into the sample receiving log; and transferring samples to the appropriate lab section for analysis. The Laboratory Sample Custodian will report to the Laboratory Project Manager.

2.6.4 Laboratory Technical Staff

The Laboratory Technical Staff will be responsible for sample analysis and identification of corrective actions.

3.0 QUALITY ASSURANCE/QUALITY CONTROL

This section defines the QA/QC requirements for the physical aspects of the construction activities and to identify procedures and forms necessary to fulfill the QA/QC function. Since the design specifications have yet to be developed, this section is presented as a preliminary description of anticipated inspections and sampling activities typically associated with these construction activities. Following completion of the RD Plan for each Phase, an addendum may be prepared to include all necessary physical inspections and testing to ensure, with a reasonable degree of certainty, that the completed construction activities meet or exceed the design criteria, plans and specifications.

QA/QC requirements for the chemical analyses during construction activities are included in the SAP and QAPP. The QA/QC requirements for air monitoring and analysis have been included in the Air Monitoring Plan.

3.1 Project Meetings

ENTACT, MCP, PNL and EnSafe will conduct periodic project meetings with USEPA and TCEQ to review construction quality assurance work.

3.1.1 Preconstruction QA/QC Meeting

A preconstruction QA/QC meeting will be held prior to starting construction. ENTACT , MCP, Ensafe, PNL and USEPA/TCEQ will attend. The agenda for this meeting will include, but not be limited to, the following:

- Review the responsibilities of each organization;
- Review lines of authority and communication for each organization;
- Discuss the established procedures or protocol for observations and tests including sampling strategies;
- Discuss the established procedures or protocol for handling construction deficiencies, repairs, and retesting;
- Review methods for documenting and reporting inspection data;
- Review methods for distributing and storing documents and reports; and
- Review work area security and health and safety protocol.

3.1.2 Progress QA/QC Meetings

Monthly progress QA meetings will be held during the course of the work to:

- Discuss the project schedule and work performed to date;
- Address and resolve (i.e.; establish corrective actions for) any existing or anticipated construction problems; and
- Discuss and resolve (i.e.; establish corrective actions for) any coordination or QA/QC problems encountered to date.

The meetings will be attended by PNL, ENTACT, EnSafe and MCP representatives as appropriate. The

meetings minutes will be documented by the IQAT. Meetings will be held monthly. The meeting frequency will be increased if deemed necessary.

3.1.3 Problem or Deficiency Meeting

A special meeting may be held when and if a problem or deficiency develops. The CQA Officer and PC shall have the authority to call such a meeting when deemed appropriate. At a minimum, the meeting shall be attended by the Supervising Contractor's RA PM, the CQA Officer, and the PC, or his designee. The purpose of the meeting is to define and resolve a problem or recurring work deficiency in the following manner:

• Define and discuss the problem or deficiency;
• Review alternative solutions; and
• Implement a plan to resolve the problem or deficiency.

Minutes of the meeting will be taken by the CQA Officer and will be transmitted to all parties and the EPA. Detailed documentation will be made when expert technical judgments are obtained and used as a basis for decision in any modification of the Work. Detailed documentation will also be mandatory for meetings dealing with major problems. After implementation of corrective action, a follow-up meeting will be conducted to evaluate the effectiveness of corrective action implemented
pursuant to the problem work deficiency meeting. The follow-up meeting will be attended by all parties involved in the work deficiency meeting.

3.1.4 Pre-Final and Final Walkthrough Inspections

Pre-final and final walkthrough inspections will be conducted to identify and correct any remaining deficiencies and to certify that the work has been accepted by the EPA and TCEQ. At a minimum, the walkthrough will be attended by the PC, Construction Manager, EnSafe, the Supervising Contractor, EPA and TCEQ

3.2 On Site Documentation

Proper documentation of site activities is an important part of the work process. To provide evidence of satisfactory work performance, field inspection and testing results will be completely documented. All QA/QC records will be maintained in accordance with the requirements of the CD as detailed in the DMP.

3.2.1 Daily Construction QA/QC Report

The Daily Construction QA/QC Report will be completed daily, beginning at the start of field activities and throughout the RD/RA by the Site QA/QC Manager. The Construction QA/QC Report will consist of, but not be limited to, the following items:

- Identification of project name, location, date and shift;
- Weather conditions, including time lost due to weather, recorded in 1/4 days lost;
- Description and location of work currently underway;
- Equipment and personnel at work, including idle or stand-by time and reasons;
- Description and location of areas being sampled;

- Description of inspection activity;
- Visitors on-site, including organizations and comments;
- Copies of inspection forms used; and
- Decisions and comments including conversations, directives, and directions for the following:
    - Acceptance or failure of inspections
    - Problems encountered and corrective actions taken
    - In-field modifications
    - Assessment of overall project quality.

All field construction and off-site laboratory verification records will be collected and maintained in the site record system. A sample Daily Construction QA/QC Report is included in Appendix A.

3.2.2 Sample Collection Documentation

During the RD/RA three forms will be filled out upon collection of a sample:

- Sample Collection Log;
- Analysis Request and Chain-of-Custody Record; and
- Sample Label.

A Sample Collection Log will be completed for each sample collected. A Sample Label will be filled out for each container used. The Analysis Request and Chain-of-Custody Record will be completed for each shipment of samples to the laboratory. Examples of the Sample Collection Log, Analysis Request and Chain-of-Custody Record and a Sample Label are included in Appendix A.

3.2.2.1 Sample Collection Log

During the RD/RA samples will be collected as described in the SAP and for each sample. A Sample Collection Log will be prepared which includes information pertaining to the location, condition, and collection of a sample. The following information is required on the Sample Collection Log, as appropriate:

- Project name and number;
- Date and time of sample collection;
- Sample collection team members;
- Sample identification number, location, and sample matrix;
- Depth of sample;
- Weather conditions;
- Number and type of sample containers; and
- Quantity of samples collected.

3.2.2.2 Analysis Request and Chain-of-Custody Record

The Analysis Request and Chain-of-Custody Record will be signed by each individual who has the samples in

his or her possession. Field preparation of this record shall be as follows:

- The Analysis Request and Chain-of-Custody Record will be initiated in the field by the person collecting the sample. Every sample will be assigned a unique identification number that is entered on the record. Samples can be grouped for shipment using a single record.
- The form will indicate the project name, sampling team, laboratory destination, special instructions, and possible sample hazards.
- If the person collecting the sample does not transport the samples to the laboratory or deliver the sample containers for shipment, the first block for Relinquished By ___, Received By ___ will be completed in the field.
- The person transporting the samples to the laboratory or delivering them for shipment shall sign the record as Relinquished By ___.
- If the samples are shipped to the laboratory by commercial carrier, the original Analysis Request and Chain-of-Custody Record will be sealed in a watertight container and placed in the shipping container. The shipping container will be sealed prior to being given to the carrier. A copy of the forms will be kept in the project files.
- If the samples are transported directly to the laboratory, the Analysis Request and Chain-of-Custody Record will be kept in possession of the person delivering the samples.
- For samples shipped by commercial carrier, the waybill will serve as an extension of the record between the final field custodian and receipt in the laboratory.

All samples will be packaged for shipment in compliance with current U.S. Department of Transportation (DOT) and commercial carrier regulations. All required government and commercial carrier shipping papers will be filled out and shipment classifications made according to current DOT regulations.

3.2.2.3 Sample Label

Sample labels are necessary to prevent misidentification of samples. Each label will contain space for the following information: name of site, sample identification, date and time of sample collection, media sampled, name of sampler, preservatives, and types of analyses to be performed.

3.2.3 Non-Conformance Report

A non-conformance report will be utilized to document activities or work products which do not meet the project requirements, approved work procedures, or the QA/QC program. The non-conformance report has been included in Appendix A and includes the following:

- Description of nonconformance;
- Identification of individual(s) identifying or originating the nonconformance;
- Method(s) for completing corrective action and corrective action taken;
- Required approval signatures for the corrective action;
- Schedule for completing corrective action; and
- Individuals responsible for correcting the nonconformance and verifying satisfactory resolution.

Documentation will be made available to construction, laboratory, and/or QA/QC personnel. It is the responsibility of the Site QA/QC Manager to notify appropriate personnel of the nonconformance. Copies of all nonconformances will be sent to the Corporate QA/QC Manager and PC within 24 hours after the identification of nonconformance work. In addition, MCP should be notified verbally, followed in writing as soon as possible of significant nonconformances which could impact the results of the work. Corrective actions must be approved by the PC prior to being implemented. Completion of corrective actions for significant nonconformances will be verified by the Site QA/QC Manager as part of future activities.

3.3 QA/QC Program

The QA/QC program developed for this project will achieve the project objectives in an effective and efficient manner.

3.3.1 QA/QC Inspections

This QA/QC program provides an organized procedure to monitor compliance through a series of inspections before, during, and after major project tasks. Prior to each major project task, a meeting will be held by the Site QA/QC Manager with EnSafe, PNL and MCP representatives as appropriate to review the specific work that will conducted and what aspects of that work will require review and inspection by QA/QC personnel. The meeting will include a review of inspection methods, acceptance criteria, inspection forms and sampling procedures, if necessary.

A four-step, QA/QC inspection system will be implemented by the Site QA/QC Manager. This four-step system will include:

1. Preparatory inspections,
2. Initial inspections,
3. Follow-up inspections and
4. Final inspections.

All inspections will be performed and documented in accordance with approved RD/RA Work Plans. This system is the means by which ENTACT will verify that the work complies with the project requirements. All inspections will be documented by the Site QA/QC Manager.

3.3.1.1 Preparatory Inspections

Preparatory inspections will be performed by the On-site QA/QC Manager prior to major project tasks or definable feature of work (e.g., building demolition, soil excavation). The inspections will include the following items:

- Review of the work scope to be completed;
- Review of CQAP and design and control testing requirements detailed in the design specifications included in each phased RD/RA Work Plan;
- Visual inspection of the work area to ascertain that all preliminary work as required has been

completed;
- Verification of all field dimensions if necessary; and
- Physical examination of equipment/materials to verify they conform to those specified and that all equipment/materials are on site.

Preparatory inspections will be reported on the Daily Construction QA/QC Report and the Preparatory Inspection Form included in Appendix A.

3.3.1.2 Initial Inspection

Initial inspections will be performed as soon as a representative segment of the particular item of work has been accomplished. The initial inspection includes an examination of the quality of workmanship and a review of the controls implemented, checking for compliance with the construction QA/QC requirements, completion of inspection forms and approval or rejection of the initial segment of the work.

The initial inspections will be reported on the Daily Construction QA/QC Report and the Initial Inspection Form included in Appendix A, and includes work-task specific inspection forms.

3.3.1.3 Follow-up Inspections

The Site QA/QC Manager will additional CQA inspections at the frequency specified in the inspection forms for the work to verify continuing compliance with the CQAP. Inspections will continue until project completion and include re-inspections as required to verify that any problems identified in the any inspection have been corrected. Follow-up inspections will be reported on the Daily Construction QA/QC Report and include inspection forms as required.

3.3.1.4 Final Inspections

At the completion of all work or increment of work, a final inspection will be conducted to verify compliance with the design drawings and specifications. Final inspections will be documented on the Final Inspection Form included in Appendix A.

The Site QA/QC Manager is responsible for initiating the final inspection and, if necessary, verifying development of a deficiency punch-list of items which do not conform to the specified requirements including incomplete work items. The punch-list will identify all nonconforming or incomplete work. Upon completion of the punch-list items, a follow-up inspection will be conducted by the Site QA/QC Manager to verify the completed work conforms to the project requirements.

3.3.2 Technical QA/QC Program

The primary technical considerations of the QA/QC program are to verify and document that the project tasks have been completed according to the specifications and design drawings. The following sections discuss each construction task, and provide QA/QC guidelines to achieve the project performance requirements for each project task. Complete CQA inspection forms for each activity will be provided in each Phase's RD/RA

Work Plans. The discussion below provides a general overview of anticipated CQA work.

3.3.2.1 Phase One RA Activities

3.3.2.1.1 Site Preparation

The first series of work activities performed at the site as part of the remedial action will be site preparation. The primary purpose of site preparation is to establish the field facilities necessary to perform remedial activities. During site preparation, the Site QA/QC Manager will monitor all activities to ensure that the tasks have been completed according to the design drawings and project specifications. The site preparation activities may include:

- Construction of access roads, parking area, and material/equipment staging area;
- Maintaining security fencing and gates;
- Installation and maintenance of temporary erosion barriers and storm water control facilities;
- Procurement of materials and equipment as required by Health and Safety Plan, Hurricane and Flooding Contingency Plan and Air Monitoring Plan.
- Ensuring that Site safety notices are posted showing Evacuation Procedures, Rally Points, Hospital Route, etc.
- Preparation for and installation of Above Ground Storage tanks, containment and other requirements as outlined in the Spill Protection Controls and Countermeasures Plan as necessary for the temporary storage of fuel and oils during RA activities.
- Protection of monitoring and injection wells and other operating equipment associated with the Storm Water Management Plan; and
- Establishment of necessary temporary offices, equipment and utility services to support the remediation work.

3.3.2.1.2 Above Ground Tank and Building Demolition

The numerous above ground tanks, laboratory, and shop buildings will be demolished during the Phase One remedial action activities. Prior to the demolition of these structures, preliminary work will be completed which includes the removal of any special waste including any LBP, ACM, mercury ballast/switches, PCB containing transformers, drums, compressed gas cylinders, and over-packs that may be presently located within and around the laboratory and shop buildings.

3.3.2.1.2.1 Inspections for Above Ground Tank and Building Demolition

During the decontamination/demolition of the above ground tanks and buildings, the Site QA/QC Manager will perform the following inspections:

- Verify that all special wastes have been removed from within and around the buildings
- Verify that all water, oil, and sludge has been removed from the tanks prior to decontamination activities
- Verify that all steel tanks have been decontaminated prior to subsequent size reduction activities or

prior to loading for offsite recycling as applicable.

3.3.2.1.3 Treatability Pilot Study

The recommended mix design from the bench scale study completed during the Phase One Pre-Design Investigation will be used to evaluate the final reagents and dosages intended for use by verifying the effects of scaling up under the actual environmental conditions at the Site.

3.3.2.1.3.1 Inspections for Treatability Pilot Study

During the execution of the treatability pilot study, the Site QA/QC Manager will perform the following inspections:

- Verify that the batch delineation has been calculated prior to solidification.
- Verify that the solidification reagents meet specifications.
- Verify that a grid system is established in each area to identify and locate the batch and corresponding sample locations.
- Verify required tests listed in Table 2 are performed and meet the specified requirements.
- Verify that the on-site storage area for solidification reagents is adequate.
- Verify that the standing water in pits is removed prior to the Pilot Study.
- Verify that the pits are in a dewatered state during the Pilot Study and the post solidification curing process.
- Verify that a log is maintained (see Solidification log in Appendix A) to document the type and quantity of solidification reagents used per unit volume of sludge.
- Verify that the solidification reagent is mixed thoroughly with sludge in accordance with the proposed mix design and the equipment used in mixing is capable of producing consistent mixture.

3.3.2.2 Phase Two RA Activities

3.3.2.2.1 Slurry Wall

Although the installation of the slurry wall was originally included as a Phase Two activity, this activity was completed during the Phase One RA. The soil-bentonite slurry wall was installed along the perimeter of the Sludge Pit and oil Pit. The slurry wall installed was approximately 3,300 feet in length constructed entirely by means of a slurry trenching method. The slurry wall was installed approximately 40 feet below the existing grade with a continuous minimum width of 3 feet and keyed into the clay layer underlying the site.

3.3.2.2.1.1 Inspection of the Slurry Wall

The QA/QC guidelines for the slurry wall construction are as follows:

Working Platform Preparation: The Site QA/QC Manager will perform the following inspections during the preparation of the working platform:

- Verify that the working platform surface is properly stripped of stumps, trees, roots, and other debris;
- Verify that the working platform surface is graded to the lines shown on the design drawings included in the Phase Two RD/RA Work Plan. This will be accomplished by surveying.
- Verify that the working platform surface is at least 2 feet above the groundwater table; and
- Verify that compaction of the fill for the working platform, if needed, is achieved by comparing density testing results of the installed fill material with the project specifications provided in the Phase Two RD/RA Work Plan.

Bentonite Slurry Preparation: The Site QA/QC Manager will verify the following during bentonite slurry preparation:

- The batching equipment is in working order.
- The water used for slurry mixing is from the source identified in the design specifications included in the Phase Two RD/RA Work Plan.
- The bentonite used is certified by the supplier and meets the specifications (refer to Table 1).
- The required tests listed in Table 1 are performed and meet the specified requirements. The samples of the slurry taken in the trench should be taken from mid-depth of the trench.
- The slurry tanks for hydration are mechanically or hydraulically agitated.
- The bentonite will be adequately hydrated.

Slurry Trench Excavation: The two critical excavation considerations are trench continuity and key depths. The continuity of the trench will be demonstrated by passing the excavation equipment vertically along the trench to ensure that the entire trench is fully excavated. All loose material will be removed from the bottom of the trench to ensure that the wall is keyed to the depths as shown on the design drawings. The depths of the trench will be sounded using a weighted tape. The Site QA/QC Manager will also verify the following:

- The trench stays within 5 feet of the design alignment and that it does not vary in verticality by more than 5 percent of the wall depth.
- Check for evidence of trench wall instability (i.e. sloughing of surface adjacent to trench, tension cracks).
- The excavation is completed to the required depth shown on the drawings.
- The specified tests listed in Table 1 are performed and the required performance is met.
- The bentonite slurry is introduced into the trench at the time excavation begins.
- The level of the bentonite slurry in the trench is maintained at a minimum of two feet above the groundwater level and two feet or less from the top of the trench in order to maintain trench stability.
- The slurry is maintained in a condition which meets the mixing and operation requirements.

Backfill Material Preparation: During the backfill material preparation, the Site QA/QC Manager will verify that:

- The bentonite powder used for mixing (if needed) will be as specified in Table 1.
- The backfill material is mixed according to the design requirements. The backfill material used is from an approved source.

- The mixing and blending produce a homogeneous mass free of large lumps or clods of soil, and free of pockets of fines, sands or gravel.
- The required tests listed in Table 1 are performed and meet the specified requirements.
  Permeability testing of the backfill mix will be performed in a laboratory on material samples collected from the material being used to backfill the trench to verify the maximum permeability of 1 x 10^{-7} cm/sec is achieved.
- The slump of the soil-bentonite backfill is as specified just prior to placement in the trench.

Clean off-site soil maybe required for backfilling purposes. The soil shall be free of roots, organic matter, or other deleterious materials.

Slurry Wall Backfill Operation: The Site QA/QC Manager will perform the following inspections during the backfill operation:

- Verify that the soil-bentonite backfill will be placed in a manner in which no pockets of slurry are trapped or formed in the slurry wall.
- Verify that the backfill is continuously placed from the beginning of the trench, in the direction of the excavation, to the end of the trench.
- Verify that the backfill will maintain a natural angle of repose between 4H:1V and 10H:1V in the trench.
- Verify that the toe of the backfill and the toe of the excavation are separated a minimum of 20 feet and a maximum of 50 feet.
- Verify that the backfill in the trench will be sounded and recorded at the beginning and the end of each shift to determine its profile, and detect fallen debris, if any.

Slurry Wall Completion: The Site QA/QC Manager will perform the following inspections:

- Verify that the slurry trench backfill is covered with a plastic sheet for a minimum of two days and a maximum of four days after backfilling to prevent moisture loss and desiccation. The completed slurry wall will be covered with a compacted soil barrier wall plug after the minimum two week consolidation period.
- Verify that the batching plant is demobilized; and
- Verify that all excavated spoil material will be stabilized as approved.

3.3.2.2.2 Solidification of Sludge

This work includes the solidification of sludges contained in Sludge Pit, Oil Pit, APIs and tanks. The impacted soils located in other areas will be excavated and consolidated in the RCRA Subtitle C equivalent cell. If any of these soils also contain sludge, it will be taken to the Sludge Pit for solidification as well, followed by placement in the cell. A minimum of four (4) cylinders (3"φ x 6" height) will be taken from each batch mix with a maximum volume of 1,000 cy. The solidified treated material will be sampled with a track hoe bucket, composited, tamped, and prepared in the field. Once prepared, the samples will be logged in, labeled, and stored on site. A UCS test per ASTM 2166 will be performed for every batch solidified at a

maximum of one test per 1,000 cubic yards (CY) of solidified material.

Once the solidified material has met the UCS, it will be excavated and placed into the on-site RCRA Subtitle C equivalent cell.

3.3.2.2.2.1 Inspections for Solidified Material

During solidification of the sludges, the Site QA/QC Manager will perform the following inspections:

- Verify that the batch delineation has been calculated prior to solidification.
- Verify that the solidification reagents meet specifications and are procured timely, to prevent delays in the construction schedule.
- Verify that a grid system is established in each area to identify and locate the batch and corresponding sample locations.
- The required tests listed in Table 2 are performed and meet the specified requirements.
- Verify that the on-site storage area for solidification reagents is adequate.
- Verify that the standing water in pits is removed prior to solidification.
- Verify that the pits are in a dewatered state during solidification and the post solidification curing process.
- Verify that a log is maintained (see solidification log in Appendix A) to document the type and quantity of solidification reagent used per unit volume of sludge.
- Verify that the solidification reagent is mixed thoroughly with sludge in accordance with the approved mix design and the equipment used in mixing is capable of producing consistent mixture.

3.3.2.2.2.2 Inspections for Solidified Material Placement

The Site QA/QC Manager will inspect and/or verify the following items prior to and during the placement of the solidified materials:

- The specified tests listed in Table 2 are performed and performance specifications are met.
- The subgrade is uniformly graded to lines and grades depicted on construction grading plans and is free of soft or wet areas.
- The subgrade material is sufficiently dry and structurally sound to ensure that all lifts of solidified material placed over it can be adequately compacted to the design requirements and project specifications.
- The solidified material is placed in 12-inch maximum loose lifts.
- The solidified material will be compacted to 90% maximum dry density (ASTM D 698), if applicable; depending on the compaction test pad testing results (refer to Phase Two RD/RA Work Plan).
- Damages to compacted lifts (i.e.; rutting by equipment) will be repaired prior to placing any overlying materials.
- The final lines and grades of the solidified material will be verified by a professional land surveyor registered in the state of Texas.

3.3.2.2.3 Designated Soil Excavation & Backfilling

A RCRA Subtitle C equivalent cell will be constructed on site. The area designated for cell construction overlies several areas that contain impacted soils which must first be excavated and backfilled to enable the cell to be constructed. Fill material from the on-site borrow area will be used as backfilling material.

3.3.2.2.3.1 Inspections for Designated Soil Excavation & Backfilling

The Site QA/QC Manager must perform the following QA/QC activities during the designated areas soil excavation activities:

- Verify that the areas are excavated to the lines and grades as shown on the design drawing (refer to Figure 3).
- Verify that the confirmation samples are taken at the bottom of excavation surface (if applicable).
- Verify that the confirmation sample testing results meet the preliminary remediation goals as included in Attachment 1 of SAP prior to backfilling.
- The specified tests listed in Table 2 are performed on backfill and performance requirements are met.
- The final lines and grades of the backfilled areas are verified by a professional land surveyor registered in the state of Texas.

3.3.2.2.4 RCRA Subtitle C Equivalent Cell Construction

A 30-acre cell will be constructed on site to contain the designated impacted soils and the solidified sludge. This cell will be equivalent to a RCRA Subtitle C cell, with leachate collection and leak detection.

3.3.2.2.4.1 Inspections of Prepared Subgrade

The Site QA/QC Manager must perform the following QA/QC activities during the cell subgrade preparation activities:

- The specified tests listed in Table 2 are performed and performance requirements are met.
- Verify that the surface has been graded per the lines and grades indicated on the design drawings;
- Verify that the subgrade is free of sharp rocks, debris, and other deleterious materials;
- Verify that the results of proof-rolling are in accordance with the requirements of the project specifications;
- Verify that the surface on which the geosynthetic liner system will be installed is acceptable.

3.3.2.2.4.2 Inspections of Geonet & Geocomposite used for the Leak Detection & Drainage Layer

The Site QA/QC Manager must perform the following QA/QC activities prior to and during the geonet and geocomposite installation activities:

- Verify that the manufacturer's product data sheets for the intended materials meet the requirements of the project specifications (refer to Table 9).

- Verify that the transmissivity and peel strength testing results performed on delivered materials are in conformance with the project specifications.
- The documentation of proper unloading and storage of the materials.
- Verify that the required manufacturer's information has been included on all delivered materials including manufacturer's name, product identification, lot number, roll number, and roll size.
- Verify that the materials are installed in accordance with the project specifications and design drawings.
- Verify that the materials are repaired in accordance with manufacturer's recommendation/project specifications.

3.3.2.2.4.3 Inspections of Geosynthetic Clay Liner

The Site QA/QC Manager must perform the following QA/QC activities prior to and during the geosynthetic clay liner (GCL) installation activities:

- Verify that the manufacturer's product data sheets for the intended materials meet the requirements of the project specifications (refer to Table 10).
- Verify that the quality control certificates provided by the manufacturer certifying that the materials delivered meet the "minimum average values" which meet or exceed all index property values guaranteed for the GCL.
- Verify that the mass per unit area and index flux testing results performed on delivered materials are in conformance with the project specifications.
- The documentation of proper unloading and storage of the materials.
- Verify that the required manufacturer's information has been included on all delivered materials including manufacturer's name, product identification, lot number, roll number, and roll size.
- Verify that the materials are installed in accordance with the project specifications and design drawings.

3.3.2.2.4.4 Inspections of HDPE (Cell) and LLDPE (Cap) Geomembranes

The Site QA/QC Manager must perform the following QA/QC activities prior to and during the high density polyethylene (HDPE) and liner low density polyethylene (LLDPE) geomembrane installation activities:

- Verify that the manufacturer's product data sheets for the intended materials meet the requirements of the project specifications (refer to Tables 3 to 8).
- Verify that the quality control certificates provided by the manufacturer certifying that the materials delivered meet the "minimum average values" which meet or exceed all property values guaranteed for the geomembranes.
- Verify that the specific gravity, thickness, tensile strength, elongation, carbon black content, and carbon black dispersion testing results performed on delivered materials are in conformance with the project specifications.
- The documentation of proper unloading and storage of the materials.
- Verify that the required manufacturer's information has been included on all delivered materials

including manufacturer's name, product identification, lot number, roll number, and roll size.
- Verify that the materials are installed in accordance with the project specifications and design drawings.
- The documentation of the testing results of non-destructive and destructive tests meet the project specifications.
- Verify that the materials are repaired in accordance with manufacturer's recommendation/project specifications.

3.3.2.2.4.5 Inspections of Leachate Collection Piping

The Site QA/QC Manager must perform the following QA/QC activities prior to and during the leachate collection pipes installation activities:

- Verify that the manufacturer's product data sheets for the intended materials meet the requirements of the project specifications (refer to Table 12).
- The documentation of the quality control certificates for each batch of HDPE pipe delivered to the site which includes the manufacturers name, lot/batch number, and sampling procedures and results of quality control tests.

3.3.2.2.4.6 Inspections of Non-woven Geotextiles used with Leachate Collection System

The Site QA/QC Manager must perform the following QA/QC activities prior to and during the geotextile installation activities:

- Verify that the manufacturer's product data sheets for the intended materials meet the requirements of the project specifications (refer to Table 13).
- Verify that the grab strength, puncture resistance, permittivity, apparent opening size, and tensile strength testing results performed on delivered materials are in conformance with the project specifications.
- The documentation of proper unloading and storage of the materials.
- Verify that the required manufacturer's information has been included on all delivered materials including manufacturer's name, product identification, lot number, roll number, and roll size.
- Verify that the materials are installed in accordance with the project specifications and design drawings.
- Verify that the materials are repaired in accordance with manufacturer's recommendation/project specifications.

3.3.2.2.4.7 Inspections of Drainage Aggregates

The Site QA/QC Manager must perform the following QA/QC activities during the drainage aggregate installation activities:

- Verify that the sieve analysis and hydraulic conductivity testing results performed on delivered

materials are in conformance with the project specifications (refer to Table 2).

3.3.2.2.4.8 Inspections of Cover Soil

The cell cover system will include 12 inches of non-structural fill and 6 inches of a vegetative soil layer. The 6-inch layer of vegetative soil is to support the vegetation and minimize the erosion.

Non-Structural Fill Placement – The Site QA/QC Manager will inspect and/or verify that the following items prior to and during the placement of the common soil layer material:

- The specified requirement tests listed in Table 2 are performed and met.
- The common fill layer is uniformly graded to the lines and grades depicted on construction grading plans and is free of soft or wet areas.
- The common fill is placed in 12-inch maximum in-place lifts.
- The minimum soil thickness listed in Specification Section 02300-3.10-D is maintained at all times.
- Damages to placed lifts (i.e.; rutting by equipment) will be repaired prior to placing any overlying materials.

Vegetative Soil Placement – The Site QA/QC Manager will inspect and/or verify that the following items prior to and during the placement of the vegetative soil layer material:

- Damages to the non-structural soil layer surface (i.e.; rutting by equipment) is repaired prior to placing the vegetative soil.
- The specified requirement tests listed in the project specifications are performed and met (refer to Table 2).
- The vegetative soil will be spread in one 6-inch lift, not compacted.
- The final lines and grades of the vegetative soil layer are as shown on the design drawings, within a tolerance of 0.2 ft. The survey will be performed by a professional land surveyor registered in the state of Texas to verify a total of 18" of cover soil has been placed over the installed geosynthetics.

3.3.2.3 Phase Three RA Activities

3.3.2.3.1 Groundwater Monitoring Well Installation and Abandonment

New monitoring wells will be installed upon completion of the cell closure. All existing monitoring wells, one nonpotable well, and two deep injection wells will be plugged and abandoned in place by a licensed driller in accordance with state laws and regulations, with individual well closure reports completed.

3.3.2.3.1.1 Inspections for Monitoring Well Installation

A total of ten (10) new monitoring wells will be installed, each constructed of 2-inch PVC pipe. The Site QA/QC Manager will perform the following QA/QC activities during well installation which will be completed in accordance with the procedures outlined in the SAP:

- Verify that wells are drilled and installed by Texas licensed drillers;
- Perform a visual inspection on the materials, verifying that the riser, screen, casing, grout, sand pack, and bentonite are in compliance with the specifications which will be included in the Phase III RD;
- Verify that wells are installed properly including inspecting monitoring well installation logs;
- Verify that well screens intersect the anticipated groundwater elevations;
- Verify that wells are free from any obstructions;
- Verify that wells are properly developed and sediment free;
- Verify that the top of the well casing has been surveyed for both horizontal and vertical positioning;
- Verification of the well pad, outer casing, locking cap, well ID, and bollards (if applicable); and
- Verification that each well installation report will be included for submittal in the RA Final Report.

3.3.2.3.1.2 Inspections for Well Abandonment

The Site QA/QC Manager must perform the following QA/QC activities during the well abandonment activities:

- Verify that wells are plugged and abandoned by Texas licensed drillers;
- Verify that well casings/bollard/slabs are removed properly;
- Verify that the boreholes are grouted in place from the bottom to the top; and
- Verify that each well receives a well closure report, for submittal in the RA Final Report at the end of the project.

3.3.2.3.2 Storm Water Control and Site Drainage

Following cover system installation, approximately 6,000 ft of perimeter channels (3 ft deep, 3 ft wide bottom, 5:1 slopes) will be installed to convey storm water from the cap channels and outer side slopes to effectively drain the storm water from the site.

3.3.2.3.2.1 Inspections for Drainage Ditch

The Site QA/QC Manager will inspect and/or verify the following items during the perimeter ditch installation:

- Verification of layout of all ditch locations.
- The slope of bottom of ditch meets the requirements of the design drawings and specifications.

3.3.2.4 Surveying

Throughout the project, the installation of various components of the RA and the completion of some tasks will be documented by way of land surveying methods. Coordinates and elevation data will be recorded for various components of the RCRA cell and other permanent features including the slurry wall, permanent monitoring wells, permanent fencing, the location and depths of impacted soil excavation boundaries, and the tracts for ICs.

4.0 NONCONFORMANCE AND CORRECTIVE ACTION

Nonconforming items and activities are those which do not meet the project requirements, approved work procedures, or the QA/QC program. Nonconformance may be detected and identified by:

- Construction Staff - during performance of field activities, site inspections, and sampling.
- Laboratory Staff - during preparation for and performance of laboratory testing, and calibration of equipment.
- Site QA/QC Manager - during performance of inspections.
- IQAT – during review of submittals, performance of inspections.

Each nonconformance affecting quality will be documented by the person identifying or originating it. For this purpose a standard ENTACT nonconformance report (Appendix A) will be used. Documentation will, when necessary, include:

- Description of nonconformance;
- Identification of individual(s) identifying or originating the nonconformance;
- Method(s) for completing corrective action and corrective action taken;
- Required approval signatures for the corrective action;
- Schedule for completing corrective action; and
- Individuals responsible for correcting the nonconformance and verifying satisfactory resolution.

Documentation will be made available to construction, laboratory, and/or QA/QC personnel. It is the responsibility of the Site QA/QC Manager to notify appropriate personnel of the nonconformance. Copies of all nonconformances will be sent to the Corporate QA/QC Manager and PC within 24 hours after the identification of nonconformance work. In addition, MCP should be notified verbally, followed in writing as soon as possible of significant nonconformances which could impact the results of the work. Corrective actions must be approved by the PC prior to being implemented. Completion of corrective actions for significant nonconformances will be verified by the Site QA/QC Manager as part of future activities.

Any significant, recurring nonconformance should be evaluated by construction, laboratory, and/or QA/QC personnel to determine its cause and appropriate changes necessary to prevent future recurrence. The results of such an evaluation will be documented in a Rework Items Log (Appendix A).

5.0 REPORTING PROCEDURES AND RECORDS MANAGEMENT

This section describes the results reporting procedures and records management.

5.1 Reporting Procedures

The results of QA/QC inspections, sampling, and other field activities, including notices of nonconformances and rework items will be reported to MCP in a timely manner. Field information will be reported by the field personnel to the Site QA/QC Manager and Project Manager. The Daily Construction QA/QC Report will be submitted to a MCP representative on the following work day.

5.2 Records Management

Specific records prepared for each activity will be dependent on the scope of work. In order to provide the project staff and MCP personnel efficient access to records, fixed filing categories will be maintained on site. The status of records will be clearly indicated so that superseded and outdated records will not be used in the completion of work activities.

5.2.1 Records Status

Standard ENTACT designations and practices for record status and verification (checking) shall apply. The following standard ENTACT definitions shall apply:

- DRAFT: Project documents issued to MCP or other agencies pending their approval. Draft indicates ENTACT's internal review is complete. The status of the document shall be listed on the Letter of Transmittal. A draft plan or document is designated as an alpha revision (e.g. Revision A is first draft, Revision B is second draft, etc.)
- PRELIMINARY: Records indicated as preliminary indicate that ENTACT's internal review has not been completed including verification of calculations, drawings, data verification and validation, tables, and text. PRELIMINARY shall be stamped on all drawings, tables, and data. The Letter of Transmittal will indicate the status of these records.
- FINAL: Final records are records that have completed the internal and external review and approval process. The Letter of Transmittal will indicate the status of these records. A final plan or document is designated as a numeric revision (e.g. Revision 0 is the approved plan, Revision 1 would denote the first time an approved plan is revised, etc.)
- CHECKED: Drawings, tables, logs, and calculations will be checked using the standard ENTACT verification procedures. The employee who performs the formal checking shall indicate by initial and date on the final record.
- APPROVED: Documents and records (e.g., drawings) requiring formal approval shall be signed and dated by the approver.

Figures

NOTES:

1. IMAGE SOURCE: GOOGLE EARTH 2012
2. THE INFORMATION PRESENTED HEREIN IS PROPRIETARY IN NATURE AND IS NOT TO BE REPRODUCED OR RE-USED WITHOUT THE EXPRESSED WRITTEN PERMISSION OF ENTACT.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

ENTACT
699 South Friendswood Dr., Suite 101
Friendswood, Texas 77546
P: 281-996-9892

DRAWING NAME: FIGURE 1
SITE LOCATION MAP

PROJECT NAME & LOCATION: MALONE SERVICE COMPANY SUPERFUND SITE
TEXAS CITY, TEXAS

DRAWN BY	J. HOUGH	APPROVED BY	G. TUNSTALL	REV	
DATE	10-23-12	DATE	10-23-12	SHEET NO.	1 OF 1
DRAWING NO.		FIGURE NO.		PROJECT NO.	P7888

NOTES:

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REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

ENTACT
699 South Friendswood Dr., Suite 101
Friendswood, Texas 77546
P: 281-996-9892

DRAWING NAME: FIG. 2 EXISTING SITE CONDITIONS

PROJECT NAME & LOCATION: MALONE SERVICE COMPANY SUPERFUND SITE TEXAS CITY, TEXAS

DRAWN BY	J. HOUGH	APPROVED BY	G. TUNSTALL	REV	
DATE	10-20-14	DATE	10-20-14	SHEET NO.	1 OF 1
DRAWING NO.		FIGURE NO.	1	PROJECT NO.	P7888

Soil Excavation Volume Report			
Source	Surface Area (sf)	Excavation Depth (ft)	Volume (cy)
Laydown Area	557,477	2	41,074
Cemetary Area	43,512	15	22,024
Maintenance Area - Pits	85,795	8	24,239
Maintenance Area - Unit 900	11,277	15	5,200
Tank 800	138,709	10	42,784
0 To 6" Removal Areas	52,262	0.5	968
		Total:	136,289

LEGEND:

- EXISTING GRADE CONTOUR — 10
- EXISTING VEGETATION
- EXISTING GRAVEL/PAVED ROAD
- EXISTING DIRT ROAD
- EXISTING DIRT PILE
- EXISTING STRUCTURE
- EXISTING TANK
- EXISTING PIPELINE
- EXISTING WATER SURFACE
- EXISTING FENCE LINE
- EXISTING POWER POLE
- EXISTING MANHOLE
- CONTROL POINT (FROM ENTACT SURVEY, OCTOBER 2010) — 1004 Z 16.9
- DEPTH OF SOIL EXCAVATION (– INDICATES CUT) — 0.5
- SOIL EXCAVATION AREAS
- PROPOSED RCRA SUBTITLE C CELL BOUNDARY
- 150' X 150' SAMPLING GRID (BASED ON ENTACT DESIGN) — A 1

NOTES:

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REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION

ENTACT
699 South Friendswood Dr., Suite 101
Friendswood, Texas 77546
P: 281-996-9892

DRAWING NAME: FIG. 3
SOIL EXCAVATION GRID SYSTEM

PROJECT NAME & LOCATION: MALONE SERVICE COMPANY SUPERFUND SITE
TEXAS CITY, TEXAS

DRAWN BY	J. HOUGH	APPROVED BY	G. TUNSTALL	REV	
DATE	2-6-13	DATE	2-6-13	SHEET NO.	1 OF 1
DRAWING NO.		FIGURE NO.	21	PROJECT NO.	P7888

Tables

Table 1: Soil-Bentonite Slurry Trench Quality Control Testing Plan

Property	Requirement	Minimum Test Frequency	Test Method	Comment
Bentonite Powder				
a. YP/PV Ratio	> 3	1 per truck	API Spec 13A	Premium Grade
b. Viscometer at 600 rpm	> 30	1 per truck	API Spec 13A	Certification by Manufacturer
c. Filtrate Loss	< 15 cc	1 per truck	API Spec 13A	
d. Moisture Content	< 10%	1 per truck	API Spec 13A	
e. Residue larger than 75 micrometers	< 4%	1 per truck	API Spec 13A	
f. Certification	No peptizing	1 per truck	Section 4	
Water for Slurry Mixing				
a. pH	6 to 9	1 per source	API RP 13B-1	
b. Hardness	< 250 ppm	1 per source	USEPA 130.2	
c. Total Dissolved Solids	< 500 ppm	1 per source	USEPA 160.1	
Initial bentonite Slurry				
a. Viscosity	> [36-40] seconds	2 per shift	API RP 13B-1	
b. Density	> 64 pcf	2 per shift	ASTM D4380	
c. Filtrate Loss	< 25 cc	2 per shift	API RP 13B-1	
d. Bentonite Content	> 6%	Per project	Weight-Volume	Demonstrate
In-Trench Bentonite Slurry				
a. Unit Weight	64 to 85 pcf	2 per shift	ASTM D4380	Also >15 pcf less than SB
b. Viscosity	> 40 seconds	2 per shift	API RP 13B-1	
SB Backfill Material				
a. Slump Cone	3 to 6 inches	1 per shift	ASTM C143	
b. Bentonite Content	Per design mix	Daily	Weight-Volume	Demonstrate
c. Density	15 pcf > In-trench slurry	1 per shift	ASTM C138 or D4380 mod	
d. Permeability	$\leq 1 \times 10^{-7}$ cm/sec	1 per week	ASTM D5084	Laboratory test

TABLE 2: TYPICAL SCHEDULE OF QUALITY CONTROL INSPECTION/TESTING

Material	Situation	Inspection/Test	Minimum Frequency	Test Method	Requirement
Structural Fill	Before/During Placement	Visual Inspection	Continuous	Visual	Relatively homogenous clean soil that is free of organic matter, debris, frozen material, deleterious materials, and excess moisture
		Soil Classification	1 per source/ 50,000 CY	ASTM D 2487 (USCS)	SW, SP, SM, SC, CL, or CH
		Particle Size	1 per source/ 50,000 CY	ASTM D422	Maximum 3 in.
		Moisture-Density Relationship	1 per source/10,000 cy	ASTM D698 Standard Proctor	No specific requirement necessary. Test will define the moisture-density relationship for a particular sample.
	As Placed	Lift Thickness	Continuous	Visual	9” loose maximum 6” loose compacted
		Field Moisture Content & Density	1 per acre/lift	ASTM D2216, ASTM D6938	≥95% Standard Proctor (ASTM D698) maximum dry density at +/- 4% of optimum moisture content

Material	Situation	Inspection/Test	Minimum Frequency	Test Method	Requirement
Non-Structural Fill	Before/During Placement	Visual Inspection	Continuous	Visual	Free from roots, organic matter, trash, debris, rocks larger than 3 inches, and other deleterious material.
		Soil Classification	1 per source/ 50,000 CY	ASTM D 2487 (USCS)	SW, SP, SM, SC, ML,CL, OL, MH, CH, or OH
		Particle Size	1 per source/ 50,000 CY	ASTM D422	Maximum 3 inch
	As-placed	Lift Thickness	Continuous	Visual	Maximum 12-inch loose lifts
Protective Cover	Before Placement	Particle Size	1 per source/50,000 CY	ASTM D422	Maximum 2 inch
	During Placement	Visual Inspection	Continuous	Visual	Relatively homogenous soil that is free of debris, foreign objects, and sharp objects
Solidified Sludge	Prior to Final Placement in RCRA Cell	UCS	1 per mixing grid or batch (1,000 CY maximum)	ASTM D 2166	Minimum 15 psi
	As-placed	Lift Thickness	1 per lift	Visual	Maximum 12-inch loose lifts
		# Passes/Compaction Equipment Utilized	1 per lift	Visual	Per requirements of the Test Fill

Material	Situation	Inspection/Test	Minimum Frequency	Test Method	Requirement
Cell Internal Berm Soil	Before/During Placement	Moisture-Density Relationship	1 per source/ 10,000 CY	ASTM D 698 Standard Proctor	No specific requirement necessary. Test will define the moisture-density relationship for a particular sample.
	As-Placed	Lift Thickness	1 per lift	Visual	Maximum 9-inch loose lifts
		Field Moisture Content & Density	1 per acre/lift	ASTM D2216, ASTM D6938	At least 95% of the maximum dry density, as determined by Standard Proctor Test, +/- 4% of optimum moisture.
#57 Aggregate (Leachate Collection/ Detection System)	Before Placement	Sieve Analysis	1 per source/ 10,000 CY	ASTM C136	Sieve Size: 1 1/2 inch, 3/8 inch, #200 — % Passing by Weight: 100, 5, 3
3/8" Aggregate (Gas Vent System)	Before Placement	Sieve Analysis	1 per source/ 10,000 CY	ASTM C136	Sieve Size: 3/8 inch, #200 — % Passing by Weight: 100, 3

Material	Situation	Inspection/Test	Minimum Frequency	Test Method	Requirement
Vegetative Soil	Before/During Placement	Visual Inspection	Continuous	Visual	Easily cultivated, relatively homogenous clean soil that is free of objectionable material including gravel, large roots, stumps, debris, or other objectionable materials.
		Particle Size w/Hydrometer	1 per source/ 10,000 CY	ASTM D422	Maximum 2 in.
		pH	1 per source/ 10,000 CY	ASTM D4972	6-9
		Soil Agronomy	1 per source/ 10,000 CY	Topsoil Analysis & Fertilizer Recommendations from a Texas Agronomist	No specific requirement necessary. Test will define soil amendments (fertilizer/lime, etc.) necessary to promote vegetative growth.
Geotextile	Upon Delivery	Visual Inspection	Each Roll	Visual	Marked or Tagged with manufacturer's name, product identification, lot or batch number, lot or batch number, roll number, and roll dimensions
	Overlap	Visual Inspection	Continuous	Visual	Minimum 6" overlap when mechanically seemed. 12" overlap for all others.
	Seaming	Visual Inspection	Continuous	Visual	Seamed with polymeric thread or thermally bonded.

Material	Situation	Inspection/Test	Minimum Frequency	Test Method	Requirement
GCL	Prior to Delivery	Bentonite Content (Mass/Area)	1 per 100,000 ft^2	ASTM D5933	Minimum 0.75 lbs/ft^2
		Hydraulic Conductivity	1 per 100,000 ft^2	ASTM D5887	Maximum 5 x 10^{-9} cm/sec
	Upon Delivery	Visual Inspection	Each Roll	Visual	Marked or Tagged with manufacturer's name, product identification, lot or batch number, lot or batch number, roll number, and roll dimensions
	Placement	Visual Inspection of Subgrade	Continuous	Visual	Relatively smooth and uniform and free of irregularities, dimples, loose soil, or abrupt grade changes. Free of standing water. Subgrade prepared with smooth-drum roller.
	Placement	Visual Inspection of GCL Panels	Each Panel	Visual	Panels generally oriented to the line of maximum slope (i.e. up and down the slope, not across the slope), minimizing folds or excessive slack
	Placement	Visual Inspection of GCL Panel Seams	Each Seam	Visual	Overlapped per Manufacturer's recommendation.

Geonet & Geo-composite	Upon Delivery	Visual Inspection	Each Roll	Visual	Marked or Tagged with manufacturer's name, product identification, lot or batch number, lot or batch number, roll number, and roll dimensions
	Placement	Visual Inspection of Subgrade	Continuous	Visual	Relatively smooth and uniform and free of irregularities, dimples, loose soil, or abrupt grade changes. Free of standing water. Subgrade prepared with smooth-drum roller.
	Placement	Visual Inspection of Geocomposite Panels	Each Panel	Visual	Panels oriented with the high transmissivity direction in the downgradient direction, minimizing folds or excessive slack
	Placement	Visual Inspection of Geocomposite Panel Seams	Each Seam	Visual	Geotextile component to be continuously sewn w/polymeric thread w/minimum 6" overlap on the top layer of geocomposites. The bottom layer (double-sided only) to be overlapped a minimum 6". Stitch type 401 per Federal Standard No. 751a, Seam Type Federal Standard Type SSN-1. Geonet to be overlapped a minimum 4" and secured with white or yellow plastic fasteners or polymer braid. Tying will be every 5 feet along the slope and 2 feet across the slope and 6 feet on horizontal surfaces. No horizontal seams higher than 1/3 the slope height on slopes steeper than 10:1
	Prior to/During Overlying Material Placement	Visual Inspection of Installed Geocomposite System	Continuous	Visual	All holes repaired per Specification Section 02073-3.05. Minimize wrinkles and overlaps during material placement. Meet max ground pressure reqs for equipment above geonets and geocomposites.

Geo-membrane	Prior to Delivery	Thickness – Lab Measurement	1 per 100,000 ft2	ASTM D5199 (Smooth) or ASTM D5994 (Textured)	Minimum 68 mils for 80-mil textured, 72 mils for 80-mil smooth, 34 mils for 40-mil textured, & 36 miles for 40-mil smooth
		Sheet Density	1 per 100,000 ft2	ASTM D1505/D792	Maximum 0.940 g/cc
		Tensile Properties	1 per 100,000 ft2	ASTM D6693 Type IV	
		Carbon Black Content	1 per 100,000 ft2	ASTM D4218	Between 2.0% and 3.0%
		Carbon Black Dispersion	1 per 100,000 ft2	ASTM D5596	Only near spherical agglomerates for 10 different views shall have 9 in Categories 1 or 2 and 1 in Category 3
		Interface Shear Strength	1 per specified in Tables 02075-3 and 02075-4 of the Construction Specifications	ASTM D5321	Per requirements of Tables 02075-3 and 02075-4 of the Construction Specifications
	Upon Delivery	Visual Inspection	Each Roll	Visual	Marked or Tagged with manufacturer's name, product identification, lot or batch number, lot or batch number, roll number, and roll dimensions
	Placement	Visual Inspection of Geomembrane Panels	Continuous	Visual	Panels generally oriented to the line of maximum slope (i.e. up and down the slope, not across the slope), minimizing folds or excessive wrinkles.

Material	Situation	Inspection/Test	Minimum Frequency	Test Method	Requirement
Geo-membrane	Placement	Visual Inspection of Geomembrane Panel Seams	Each Seam	Visual	Minimum 3" Overlap, bonding surfaces cleaned (mechanical abrasion for extrusion welded seams). Intersections of 3 or 4 panels to be covered with a patch.
	Welding Trial Test Seams	Shear and Peel Strength	Each Day Prior to Field Seeming and Once Every Four Hours During Continuous Operation	GRI GM-19 (Using ASTM D6392)	Requirements of Table 02075-6 of the Construction Specifications.
	Non-Destructive Testing	Vacuum Test	Continuous	GRI GM-6	Single Weld Seams – Vacuum box testing. Vacuum >3 psi for a minimum of 15 seconds for each section Double Weld Seams – Air pressure testing. Pressure >30 psi for a minimum of 5 minutes. Pressure loss tests in accordance with GRI Test Method GM-6. Pressure losses over a measurement period of 5 minutes following a 2 minute pressurized stabilization period will not exceed 4 psi. Extrusion Seams – 5 psi vacuum, 10 second hold
	Destructive Testing	Shear Strength, Shear Elongation at Break, Peel Strength, Peel Separation	One Test Location per 500 ft of seam length per seamer/welder combination	GRI GM-19 (using ASTM D6392)	Requirements of Table 02075-6 of the Construction Specifications for Fusion and Extrusion Seams.

Material	Situation	Inspection/Test	Minimum Frequency	Test Method	Requirement
HDPE Pipe	Upon Delivery	Visual	Each Lot	Visual	Name of pipe manufacturer, nominal pipe size, standard dimension ratio (SDR), the letters PE followed by the polyethylene grade per ASTM D1248, followed by the Hydrostatic Design basis in 100's of psi (e.g., PE 3408 and PE 4710), manufacturing Standard Reference (e.g., ASTM F714-1), and a production code from which the date and place of manufacture can be determined.
	After Installation of non-perforated HDPE pipe conveying liquids	Hydrostatic Test	Each Section		HDPE pipe with thermal fusion joints will be tested at 1 ½ times the working pressure. Pressure drop to be less than 1% after one hour. Maximum test section is 2,000 lf.

TABLE 3
MATERIAL SPECIFICATIONS
40-mil LINEAR LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANE – SMOOTH

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUES	TEST METHOD	MQC TESTING FREQUENCY (Minimum)
Thickness: Nominal	min. avg.	mil	40[(1)]	ASTM D5199	per roll
lowest individual of 10 values		mil	36		
Density	maximum	g/cc	0.939	ASTM D1505 ASTM D792	200,000 lb
Tensile Properties (each direction)	min. avg.			ASTM D6693 Type IV	20,000 lb
Break Strength		lb/in.	152		
Break Elongation		percent	800		
2% Modulus	maximum	lb/in.	2,400	ASTM D5323	per formulation
Tear Resistance	min. avg.	lb	22	ASTM D1004	45,000 lb
Puncture Resistance	min. avg.	lb	56	ASTM D4833	45,000 lb
Axi-Symmetric Break Resistance Strain	minimum	percent	30	ASTM D5617	per formulation
Carbon Black Content	range	percent	2.0 to 3.0	ASTM D4218[(2)]	20,000 lb
Carbon Black Dispersion		cat.	note[(3)]	ASTM D5596	45,000 lb
Oxidative Induction Time (OIT)	min. avg.				200,000 lb
Standard OIT; or		minutes	100	ASTM D3895	
High Pressure OIT		minutes	400	ASTM D5885	
Oven Aging at 85°C and 90 days	min. avg.			ASTM D5721	per formulation
Standard OIT; or		% ret.	35	ASTM D3895	
High Pressure OIT		% ret.	60	ASTM D5885	
UV Resistance at cycle of 20 hr UV at 75°C then 4 hr condensation at 60°C	min. avg.	% ret.	35	ASTM D5885	per formulation
High Pressure OIT at 1600 hrs					

Notes:

(1) The average of the 10 readings shall meet or exceed the nominal specified thickness of 40 mils.

(2) Other methods such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views shall have 9 in Categories 1 or 2 and 1 in Category 3.

(4) This specification is based on the Geosynthetic Research Institute (GRI) GM-17 Specification, currently the industry standard. Specified test methods and parameters may be modified by the Design Engineer to be consistent with changes to the industry standard for 40 mil smooth LLDPE geomembranes.

TABLE 4
MATERIAL SPECIFICATIONS
40-mil LINEAR LOW DENSITY POLYETHYLENE (LLDPE) GEOMEMBRANE – TEXTURED

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUES	TEST METHOD	MQC TESTING FREQUENCY (Minimum)
Thickness: Nominal	min. avg.	mil	40(1)	ASTM D5994	per roll
8 out of 10 values must exceed		mil	36		
all 10 values must exceed		mil	34		
Asperity Height(2)	min. avg.	mil	10	ASTM D7466	every 2nd roll(3)
Density	maximum	g/cc	0.939	ASTM D1505 ASTM D792	200,000 lb
Tensile Properties (each direction)	min. avg.			ASTM D6693 Type IV	20,000 lb
Break Strength		lb/in.	60		
Break Elongation		percent	250		
2% Modulus	maximum	lb/in.	2400	ASTM D5323	per formulation
Tear Resistance	min. avg.	lb	22	ASTM D1004	45,000 lb
Puncture Resistance	min. avg.	lb	44	ASTM D4833	45,000 lb
Axi-Symmetric Break Resistance Strain	minimum	percent	30	ASTM D5617	per formulation
Carbon Black Content	range	percent	2.0 to 3.0	ASTM D4218(4)	20,000 lb
Carbon Black Dispersion		cat.	note(5)	ASTM D5596	45,000 lb
Oxidative Induction Time (OIT)	min. avg.				200,000 lb
Standard OIT; or		minutes	100	ASTM D3895	
High Pressure OIT		minutes	400	ASTM D5885	
Oven Aging at 85°C and 90 days	min. avg.			ASTM D5721	per formulation
Standard OIT; or		% ret.	35	ASTM D3895	
High Pressure OIT		% ret.	60	ASTM D5885	
UV Resistance at cycle of 20 hr UV at 75°C then 4 hr condensation at 60°C	min. avg.	% ret.	35	ASTM D5885	per formulation
High Pressure OIT at 1600 hrs					

Notes:

(1) The average of the 10 readings shall meet or exceed the nominal specified thickness of 40 mils.

(2) Of 10 readings, 8 of 10 must be ≥ 7 mils and lowest individual reading must be ≥ 5 mils.

(3) Alternate the measurement side for double-sided textured sheet.

(4) Other methods such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views shall have 9 in Categories 1 or 2 and 1 in Category 3.

(6) This specification is based on the Geosynthetic Research Institute (GRI) GM-17 Specification, currently the industry standard. Specified test methods and parameters may be modified by the Design Engineer to be consistent with changes to the industry standard for 40 mil textured LLDPE geomembranes.

TABLE 5
MATERIAL SPECIFICATIONS
80-mil HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE – SMOOTH

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUES	TEST METHOD	MQC TESTING FREQUENCY (Minimum)
Thickness: Nominal	min. avg.	mil	80[1]	ASTM D5199	per roll
lowest individual of 10 values		mil	72		
Density	minimum	g/cc	0.940	ASTM D1505/ D792	200,000 lb
Tensile Properties (each direction)				ASTM D6693 Type IV	20,000 lb
1. Tensile Strength at Yield	min. avg.	lb/in.	168		
2. Tensile Strength at Break	min. avg.	lb/in.	304		
3. Elongation at Yield	min. avg.	percent	12		
4. Elongation at Break	min. avg.	percent	700		
Tear Resistance	min. avg.	lb	56	ASTM D1004	45,000 lb
Puncture Resistance	min. avg.	lb	144	ASTM D4833	45,000 lb
Stress Crack Resistance[2]	minimum	hours	300	ASTM D5397	per GRI GM-10
Carbon Black Content	range	percent	2.0 to 3.0	ASTM D4218[3]	20,000 lb
Carbon Black Dispersion		cat.	note[4]	ASTM D5596	45,000 lb
Oxidative Induction Time (OIT)					200,000 lb
1. Standard OIT; or	min. avg.	minutes	100	ASTM D3895	
2. High Pressure OIT	min. avg.	minutes	400	ASTM D5885	
Oven Aging at 85°C and 90 days				ASTM D5721	per formulation
1. Standard OIT; or	min. avg.	% ret.	55	ASTM D3895	
2. High Pressure OIT	min. avg.	% ret.	80	ASTM D5885	
UV Resistance at 20 hr UV at 75°C then 4 hr condensation at 60°C				ASTM D7238	per formulation
1. High Pressure OIT at 1600 hrs	min. avg.	% ret.	50	ASTM D5885	
Interface Shear Strength (smooth geomembrane to geosynthetic clay liner)	minimum	degrees	Failure Envelope[5]	ASTM D5321	Note 5
Interface Shear Strength (smooth geomembrane to geonet)	minimum	degrees	Failure Envelope[5]	ASTM D5321	Note 5

Notes:

(1) The average of the 10 readings will meet or exceed the nominal specified thickness of 80 mils.

(2) Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation.

(3) Other methods such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views will have 9 in Categories 1 or 2 and 1 in Category 3.

(5) Interface shear strength testing will be performed by a qualified, independent third-party geosynthetics testing laboratory prior to shipping. Interfaces identified above will have effective-stress interface strengths that meet or exceed the following:

e	Interface Shear Strength (degrees)	
	Peak	Large-Displacement
120	8.3	3.6
1,800	8.6	4.8

Interface shear tests will be performed at the normal stresses indicated above, using fresh specimens for each test configuration. The adjacent interface may be tested in one test configuration (e.g., geonet to geomembrane to geosynthetic clay liner). The geosynthetic clay liner will be tested in a hydrated condition. The geosynthetic clay liner will be hydrated at low stress, and then consolidated for a 24-48 hours before shearing.

Passing interface strength results for a particular interface are applicable from project-to-project at the site (e.g., for subsequent subcell/phase construction, etc.) and testing need not be repeated, provided that the geosynthetic type and soil source/properties proposed for use remains representative of those tested.

(6) This specification is based on the Geosynthetic Research Institute (GRI) GM-13 Specification, currently the industry standard. Specified test methods and parameters may be modified by the Project Engineer to be consistent with changes to the industry standard for 80 mil smooth HDPE geomembranes.

TABLE 6
MATERIAL SPECIFICATIONS
80-mil HIGH DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE – TEXTURED

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUES	TEST METHOD	MQC TESTING FREQUENCY (Minimum)
Thickness: Nominal	min. avg.	mil	80(1)	ASTM D5994	per roll
8 out of 10 values must exceed		mil	72		
all 10 values must exceed		mil	68		
Asperity Height(2)	min. avg.	mil	10	ASTM D7466	every 2nd roll
Density	minimum	g/cc	0.940	ASTM D1505/ D792	200,000 lb
Tensile Properties (each direction)				ASTM D6693 Type IV	20,000 lb
1. Tensile Strength at Yield	min. avg.	lb/in.	168		
2. Tensile Strength at Break	min. avg.	lb/in.	120		
3. Elongation at Yield	min. avg.	percent	12		
4. Elongation at Break	min. avg.	percent	100		
Tear Resistance	min. avg.	lb	56	ASTM D1004	45,000 lb
Puncture Resistance	min. avg.	lb	120	ASTM D4833	45,000 lb
Stress Crack Resistance(3)	minimum	hours	300	ASTM D5397	per GRI GM-10
Carbon Black Content	range	percent	2.0 to 3.0	ASTM D4218(4)	20,000 lb
Carbon Black Dispersion		cat.	note(5)	ASTM D5596	45,000 lb
Oxidative Induction Time (OIT)					200,000 lb
1. Standard OIT; or	min. avg.	minutes	100	ASTM D3895	
2. High Pressure OIT	min. avg.	minutes	400	ASTM D5885	
Oven Aging at 85°C and 90 days				ASTM D5721	per formulation
1. Standard OIT; or	min. avg.	% ret.	55	ASTM D3895	
2. High Pressure OIT	min. avg.	% ret.	80	ASTM D5885	
UV Resistance at 20 hr UV at 75°C then 4 hr condensation at 60°C				ASTM D7238	per formulation
1. High Pressure OIT at 1600 hrs	min. avg.	% ret.	50	ASTM D5885	
Interface Shear Strength (textured geomembrane to geosynthetic clay liner)	minimum	degrees	Failure Envelope(6)	ASTM D5321	Note 6
Interface Shear Strength (textured geomembrane to double-sided geocomposite)	minimum	degrees	Failure Envelope(6)	ASTM D5321	Note 6

Notes:

(1) The average of the 10 readings will meet or exceed the nominal specified thickness of 80 mils.

(2) Of 10 readings, 8 of 10 must be ≥ 7 mils and lowest individual reading must be ≥ 5 mils.

(3) Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation.

(4) Other methods such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.

(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views will have 9 in Categories 1 or 2 and 1 in Category 3.

(6) Interface shear strength testing will be performed by a qualified, independent third-party geosynthetics testing laboratory prior to shipping. Interfaces identified above will have effective-stress interface strengths that meet or exceed the following:

Normal Stress (psf)	Interface Shear Strength (degrees)	
	Peak	Large-Displacement
120	8.3	3.6
1,800	8.6	4.8

Interface shear tests will be performed at the normal stresses indicated above, using fresh specimens for each test configuration. The adjacent interface may be tested in one test configuration (e.g., double-sided geocomposite to geomembrane to geosynthetic clay liner). The geosynthetic clay liner will be tested in a hydrated condition. The geosynthetic clay liner will be hydrated at low stress, and then consolidated for a 24-48 hours before shearing.

Passing interface strength results for a particular interface are applicable from project-to-project at the site (e.g., for subsequent subcell/phase construction, etc.) and testing need not be repeated, provided that the geosynthetic type and soil source/properties proposed for use remains representative of those tested.

(7) This specification is based on the Geosynthetic Research Institute (GRI) GM-13 Specification, currently the industry standard. Specified test methods and parameters may be modified by the Project Engineer to be consistent with changes to the industry standard for 80 mil smooth HDPE geomembranes.

TABLE 7
CQA CONFORMANCE TESTING REQUIREMENTS FOR GEOMEMBRANES

TEST	METHOD	MINIMUM FREQUENCY OF CQA TESTING[1]
Thickness – Lab Measurement[2]	ASTM D5199 or D5994	1 per 100,000 ft^2
Sheet Density	ASTM D1505/D792	1 per 100,000 ft^2
Tensile Properties	ASTM D6693 Type IV	1 per 100,000 ft^2
Carbon Black Content	ASTM D 4218	1 per 100,000 ft^2
Carbon Black Dispersion	ASTM D 5596	1 per 100,000 ft^2
Interface Shear Strength	ASTM D 5321	1 per interface specified in Tables 02075-3 and 02075-4[3]

Notes:
(1) CQA testing frequency will also be at a minimum of one per resin lot.
(2) Thickness of smooth geomembranes will be measured in accordance with ASTM D5199. Thickness of textured geomembranes will be measured in accordance with ASTM D5994.
(3) See Tables 02075-3 and 02075-4 for information on testing conditions.
(4) Specified test methods and parameters may be replaced by Design Engineer to be consistent with the industry standard for geomembranes.

TABLE 8
WELDED SEAM SPECIFICATIONS FOR GEOMEMBRANES

PROPERTY	QUALIFIER	UNITS	VALUES[1, 2]		TEST METHOD[3]	CQA TESTING FREQUENCY
			40 mil LLDPE (smooth and textured)	80 mil HDPE (smooth and textured)		
Fusion Seams						
Air Test	-	psi	30 psi pressure, 5 minute hold, pressure must not drop by 3 psi		ASTM D5820	Observe Installer testing 100% of fusion seams
Shear Strength	Minimum	lb/in.	60	160	GRI GM-19 (using ASTM D6392)	(4) and (5)
Shear Elongation at Break	Minimum	%	50	50		
Peel Strength	Minimum	lb/in.	50	121		
Peel Separation	Minimum	%	25	25		
Extrusion Seams						
Vacuum Test	-	psi	5 psi vacuum, 10 second hold		ASTM D5641	Observe Installer testing 100% of extrusion seams
Shear Strength	Minimum	lb/in.	60	160	GRI GM-19 (using ASTM D6392)	(4) and (5)
Shear Elongation at Break	Minimum	%	50	50		
Peel Strength	Minimum	lb/in.	44	104		
Peel Separation	Minimum	%	25	25		

Notes:
(1) For all destructive tests, 4 of 5 samples must meet or exceed the above values, and all samples must meet or exceed 80% of the above values for a test to pass.
(2) Locus-of-break patterns will meet the acceptable break codes given in GRI GM-19. The following are patterns are unacceptable break codes: fusion – AD, AD-Brk >25%; extrusion – AD1, AD2, AD-WLD (if strength is not achieved)
(3) This specification is based on the Geosynthetic Research Institute (GRI) GM-19 Specification, currently the industry standard for welded geomembrane seams. Specified test methods and parameters may be modified by the Design Engineer to be consistent with changes to the industry standard for geomembrane seams.
(4) Trial seams will be made by the Installer (and observed/documented by CQA personnel) at start of each day and at re-start after breaks, shift change, etc. Elongation/separation measurements may be eliminated for field testing.
(5) Destructive tests will be taken at a minimum frequency of one per 500 linear feet of welded production seam.

TABLE 9
MATERIAL SPECIFICATIONS
GEONET AND GEOCOMPOSITES

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUES	TEST METHOD	MQC TESTING FREQUENCY
Geotextile Component of the Geocomposites					
Type			nonwoven		
Mass Per Unit Area	minimum	oz/yd^2	8	ASTM D5261	1 per 100,000 ft^2
Grab Tensile Strength	minimum	lbs	160	ASTM D4632	1 per 100,000 ft^2
Trapezoidal Tear Strength	minimum	lbs	60	ASTM D4533	1 per 100,000 ft^2
Puncture Strength	minimum	lbs	315	ASTM D6241	1 per 100,000 ft^2
Apparent Opening Size	maximum	inches	0.008	ASTM D4751	1 per 540,000 ft^2
Water Permeability	minimum	cm/s	0.1	ASTM D4491	1 per 540,000 ft^2
UV Resistance	minimum	percent	70	ASTM D4355	Per formulation
Geonet (and Geonet Component of the Geocomposites)					
Polymer Composition	minimum	percent	95% polyethylene		
Thickness	minimum	inches	0.20	ASTM D5199	1 per 100,000 ft^2
Tensile Strength (MD)	minimum	lb/inch	40	ASTM D7179	1 per 100,000 ft^2
Carbon Black Content	minimum	%	2.0	ASTM D4218	1 per 100,000 ft^2
Density	minimum	g/cc	0.935	ASTM D792 or ASTM D1505	1 per 100,000 ft^2
Transmissivity (Geonet only – see below for geocomposites)	minimum	m^2/s	3.0×10^{-3}	ASTM D4716 per GRI GC 8, Part 6	Note 1
Geocomposites					
LDS Geonet (floor) and Geocomposite (sideslope) Transmissivity	minimum	m^2/s	3.5×10^{-4}	ASTM D4716 per GRI GC 8, Part 6	Note 1
LCS Geocomposite Transmissivity	minimum	m^2/s	3.0×10^{-3}	ASTM D4716 per GRI GC 8, Part 6	Note 1
Final Cover Drainage Layer Geocomposity Transmissivity	minimum	m^2/s	5.3×10^{-4}	ASTM D4716 per GRI GC 8, Part 6	Note 2

Notes:

(1) Transmissivity refers to index transmissivity. LDS and LCS transmissivity test be performed between two steel plates at: applied stress of 2,000 psf (minimum); target gradient of 0.004 (minimum); and load duration of 15 minutes.

(2) Transmissivity refers to index transmissivity. Final cover drainage layer geocomposite transmissivity test be performed between two steel plates at: applied stress of 180 psf (minimum); target gradient of 0.03 (minimum); and load duration of 15 minutes.

(3) There is no hydraulic transmissivity specification for the final cover gas vent layer geocomposite.

TABLE 10
MATERIAL SPECIFICATIONS
GEOSYNTHETIC CLAY LINER

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUES	TEST METHOD	MQC TESTING FREQUENCY
Bentonite					
Bentonite Swell Index	minimum	ml/2g	24	ASTM D5890	1 per 50 tons (min. 1 per rail car)
Fluid Loss	maximum	ml	18	ASTM D5891	1 per 50 tons (min. 1 per rail car)
GCL					
Bentonite Content (Mass/Area), Oven Dried Basis	Minimum	lbs/ft^2	0.75	ASTM D5993	1 per 40,000 ft^2
Tensile Strength, Machine Direction (MD)	Minimum	lb/in.	23	ASTM D6768	1 per 200,000 ft^2
Hydraulic Conductivity	maximum	cm/sec	5×10^{-9}	ASTM D5887	1 per 200,000 ft^2

Notes:

(1) Specified test methods and parameters may be modified by the Project Engineer to be consistent with changes to the industry standard for GCLs.

TABLE 11
CQA CONFORMANCE TESTING REQUIREMENTS FOR GEOSYNTHETIC CLAY LINER

TEST	METHOD	MINIMUM FREQUENCY OF CQA TESTING
Bentonite Content (Mass/Area)	ASTM D5993	1 per 100,000 ft^2
Hydraulic Conductivity	ASTM D5887	1 per 200,000 ft^2

TABLE 12
REQUIRED PROPERTIES
FOR HDPE PIPE MATERIAL

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUE	TEST METHOD
Density	between	g/cc	0.941 – 0.957	ASTM D1505
Melt Flow	maximum	g/min.	0.15	ASTM D1238, Condition E
Flexural Modulus	between	psi	110,000 – 160,000	ASTM D790
Tensile Strength at Yield	minimum	psi	3,200 – 5,000	ASTM D638
ECSR	minimum	hrs	5,000	ASTM D1693, Condition C
Pent	minimum	hrs	500 for PE 4710 or 100 for PE 3408	ASTM F1473
Hydrostatic Design Basis	minimum	psi	1,500 (@ 23° C	ASTM D2837

TABLE 13
MATERIAL SPECIFICATIONS FOR NONWOVEN GEOTEXTILE

PROPERTY	QUALIFIER	UNITS	SPECIFIED VALUES (1)	TEST METHOD	MQC TESTING FREQUENCY
Type			Nonwoven		
Mass Per Unit Area	minimum	oz/yd^2	8	ASTM D5261	1 per 100,000 ft^2 (min. 1 per lot)
Apparent Opening Size (O_{95})	maximum	inches	0.008	ASTM D4751	1 per 540,000 ft^2 (min. 1 per lot)
Grab Tensile Strength	minimum	lbs	160	ASTM D4632	1 per 100,000 ft^2 (min. 1 per lot)
Trapezoidal Tear Strength	minimum	lbs	60	ASTM D4533	1 per 100,000 ft^2 (min. 1 per lot)
Puncture Strength	minimum	lbs	315	ASTM D6241	1 per 100,000 ft^2 (min. 1 per lot)
Water Permeability	minimum	cm/s	0.10	ASTM D4491	1 per 540,000 ft^2 (min. 1 per lot)
UV Resistance	minimum	percent	70	ASTM D4355	Per formulation

Notes:

(1) All values represent minimum average roll values.

(2) Specified test methods and parameters may be modified by the Engineer to be consistent with changes to the industry standard for the specified type of nonwoven geotextile.

Appendix A

QA/QC Forms

ENTACT

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Report No.	**Subcontract No.**	**Date**
CQC Project Title:		
Location of Work:		
Description:		
Weather:		

Rainfall		**inches**	**Temp:**	**Min.**		**Max.**	

1. Personnel

Staff		Health & Safety		Crew		Total		Cum. Total
No.	Man-hrs	No.	Man-hrs	No.	Man-hrs	No.	Man-hrs	

Cumulative ENTACT Total:

Subcontractors

No.	Man-hrs	

Cumulative Subcontractor Total:

CUMULATIVE OVERALL TOTAL:

2. Major Equipment Onsite

Equipment No.	Description	Owned	Rented	In EZ

Daily Construction Quality Control Report Entact, LLC
3. Work Performed Today by Contractor
4. Work Performed Today by Lower-Tier Subcontractors
5. List Specific Control Activities Performed and Results of These Activities (include inspections, findings, and corrective actions)
6. List Types and Locations of Tests Performed and Results of These Tests
7. Verbal Instructions Received
8. Submittal Actions
9. Delivery of Equipment and Materials
10. Samples Shipped

Daily Construction Quality Control Report **Entact, LLC**
11. Health and Safety
a. Health and Safety Meeting Conducted:
b. Air Monitoring Equipment Calibrated:
c. Air Monitoring Activity Performed: (Results attached, if any)
d. Incidents Occurred: (Incident Report attached, if any)
e. Safety Audits Performed: (Auditor's Name and Results attached)
12. Remarks:
CERTIFICATION: I certify that the above report is complete and correct and that I, or my authorized representative, have inspected the work performed this day by the contractor and each subcontractor, and have determined that all materials, equipment, and workmanship are in strict compliance with the Drawings and Technical Specifications except as may be noted above. ***ENTACT Site Representative*** _____

CHAIN OF CUSTODY RECORD

Sample Type:
□ Treated Stockpile
□ Untreated Stockpile
□ Excavation Verification
□ Air _____
□ Groundwater
□ Other _____

ENTACT

□ **HOUSTON OFFICE**
699 S. FRIENDSWOOD DRIVE
SUITE 101
FRIENDSWOOD, TX 77546
281.996.9892
281.996.9888 f

□ **DALLAS OFFICE**
3129 BASS PRO DRIVE
GRAPEVINE, TX 76053
972.580.1323
972.550.7464 f

"Safety keeps you ENTACT"

PROJECT INFORMATION

NAME	JOB NUMBER
LOCATION	PHONE
CONTACT	EMAIL

REQUIRED TURNAROUND
□ Standard
□ 5 Day
□ 3 Day
□ 48 Hour
□ 24 Hour

DETECTION LIMIT CRITERIA

COMMENTS

SAMPLE				TYPE			PRESERVATIVE					AIR				ANALYSES / METHOD												
NUMBER	DESCRIPTION	DATE	TIME	MATRIX	GRAB	COMPOSITE	HCL	HNO3		NONE	ICE	FLOW RATE (m^3)	RUN TIME (min)	VOLUME	NUMBER OF CONTAINERS SUPPLIED FOR EACH SAMPLE											FILTERED Y / N FIELD / LAB ____ MICRON FILTER	

SHIPPING METHOD:	AIRBILL NO:	SAMPLER:	LAB NAME:

RELINQUISHED BY:	DATE	RELINQUISHED BY:	DATE	RELINQUISHED BY:	DATE	LAB JOB ID
SIGNATURE:		SIGNATURE:		SIGNATURE:		
PRINTED NAME:	TIME	PRINTED NAME:	TIME	PRINTED NAME:	TIME	
RECEIVED BY:	DATE	RECEIVED BY:	DATE	RECEIVED BY:	DATE	TEMPERATURE UPON RECEIPT
SIGNATURE:		SIGNATURE:		SIGNATURE:		
PRINTED NAME:	TIME	PRINTED NAME:	TIME	PRINTED NAME:	TIME	

Media: S - Soil W - Water A - Air **Distribution:** White Copy - To Customer w/Report Pink Copy - To Job File Yellow Copy - To Lab

ENTACT

PREPARATORY INSPECTION FORM	DATE:	PAGE ____ OF _____

PROJECT NO:	TITLE AND LOCATION	DOCUMENT NO:
CONTRACTOR:	NAME OF SUPERINTENDENT:	

REVIEW OF CONTRACTOR/DELIVERY ORDER REQUIREMENTS (list specification references as appropriate):

LIST APPLICABLE DRAWINGS AND SUBMITTALS:

CONTROL TEST	TEST PROCEDURES	FREQUENCY

MATERIAL/EQUIPMENT NEEDED	AVAILABLE	RECEIVING INSPECTION COMPLETED

HAVE SUBCONTRACTORS BEEN NOTIFIED OF REQUIREMENTS? YES_____ NO_____

SUBCONTRACTOR	WORK ACTIVITY

HAS ALL PRELIMINARY WORK BEEN COMPLETED? YES_____ NO_____

QC Engineer Date

ENTACT

INITIAL INSPECTION FORM	DATE:	PAGE ____ OF _____

PROJECT NO: CONTRACTOR:	TITLE AND LOCATION NAME OF SUPERINTENDENT:	DOCUMENT NO:

DESCRIPTION OF THE WORK BEING INSPECTED

REQUIRED INSPECTIONS	DESIGN SPECIFICATION REFERENCES

ACCEPTANCE CRITERIA	TEST PROCEDURES	FREQUENCY

MATERIAL/EQUIPMENT NEEDED	AVAILABLE	RECEIVING INSPECTION COMPLETED

MATERIAL/EQUIPMENT CERTIFICATIONS

CONTRACT VARIANCE

COMMENTS

_____

QC Engineer Date

ENTACT

FINAL INSPECTION FORM	DATE:	PAGE ____ OF _____

PROJECT NO:	TITLE AND LOCATION	DOCUMENT NO:
CONTRACTOR:	NAME OF SUPERINTENDENT:	

INSPECTED WORK: COMPLETION DATE:

PERFORMANCE SPECIFICATION BY CONTRACT REFERENCE	STATUS OF INSPECTION

I certify that the work inspected is complete and meets the performance specifications cited above and that all material and equipment used and work performed was completed in accordance with approved plans and work instructions and meets contract requirements.

_____

QC Engineer Date

ENTACT

Nonconformance Report

1	**PROJECT NAME:**			2	**JOB NO.**
3	**LOCATION:**	4	**DATE:**	5	**NCR NO.**

6 **DESCRIPTION OF NON-CONFORMANCE:**

PREPARED BY: _____ DATE: _____

QA/QC Engineer

REVIEWED BY: _____ DATE: _____

QA/QC Manager

7 **DISPOSITION:**

RECOMMENDED BY: _____ DATE: _____

REVIEWED BY: _____ DATE: _____

QA/QC Engineer

8 **CORRECTIVE ACTION VERIFICATION:**

IMPLEMENTED BY: _____ DATE: _____

VERIFIED BY: _____ DATE: _____

QA/QC Engineer

9 **NCR CLOSE-OUT** _____ **DATE:** _____

QA/QC Manager

ENTACT

REWORK ITEMS LOG

REWORK ITEMS LIST

Malone Service Company Superfund Site

Project No.:

Location: Texas City. Texas

NUMBER	DATE IDENTIFIED	DESCRIPTION	CONTRACT REQUIREMENT (Spec. Section and Par. No., Drawing No. and Detail No., etc.)	ACTION TAKEN BY QC MANAGER	RESOLUTION	DATE COMPLETED

ENTACT

Solidification Log

Date: _____

Batch No: _____

* Weight of Material Based on Unit Wt. of Soil = ____ lbs/cf

				A	B	C	D	E	F	G
Batch #	**Reagent Type**	**Approx. Start Time**	**Approx. End Time**	**Grid Area (sf)**	**Grid Depth (ft)**	**Grid Volume (cf)**	**Grid Weight (lbs)***	**Grid Weight (tons)**	**Dosage of Reagent Req'd (%)**	**Weight of Reagent Req'd (tons)**
Calculation Notes				*Based on Pre-Determined Area*	*Based on Required Depth*	*= A X B*	*= C x Soil Unit Weight*	*= D / 2000*	*Per Design*	*= F x E*
Totals:				**0**		**0**	**0**	**0**		**0**

Appendix B

Example Task-Specific Inspection Forms

TABLE CQAP I

CQA Inspection and Testing

Construction Quality Assurance Plan

Malone Service Company Superfund Site, Texas City, Texas

Work Component	Reporting Form
Phase I RA Activities	
Site Preparation	CQAP I-1-R
Above-Ground Tank & Building Demolition	CQAP I-2-R
Treatability Pilot Study	CQAP I-3-R
Slurry Wall	CQAP II-1-R
Phase II RA Activities	
Sludge Solidification	CQAP II-2-R
Solidified Material Placement	CQAP II-3-R
RCRA Cell Prepared Subgrade	CQAP II-4-R
RCRA Cell Geonet & Geocomposite Installation	CQAP II-5-R
RCRA Cell Geosynthetic Clay Layer Installation	CQAP II-6-R
RCRA Cell HDPE & LLDPE Geomembrane Installation	CQAP II-7-R
RCRA Cell HDPE Pipe Installation	CQAP II-8-R
RCRA Cell Non-woven Geotextile Installation	CQAP II-9-R
RCRA Cell Cover Soil Placement	CQAP II-10-R
RCRA Cell Vegetative Soil Placement	CQAP II-11-R
Fill Placement	CQAP II-12-R
Soil Excavation & Consolidation	CQAP II-13-R
Phase III RA Activities	
Monitoring Well Installation	CQAP III-1-R
Monitoring Well Abandonment	CQAP III-2-R
Drainage Ditch Construction	CQAP III-3-R

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-2-R
Construction Inspection
Sludge Solidification
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Batch delineation/reagent quantity calculated prior to treatment?	_____	_____
• Is on-site storage area for reagents adequate?	_____	_____
• Standing water removed and area generally dewatered?	_____	_____
• Solidification Log completed?	_____	_____
• Are the reagents mixed thoroughly with sludge creating a homogenous mixture from top to bottom?	_____	_____
• Samples collected for UCS testing?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-3-R
Construction Inspection
Solidified Material Placement
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Is UCS > 15psi with no free liquids being expressed?	_____	_____
• Has the material been placed in maximum 12-inch loose lifts?	_____	_____
• Has material been placed/compacted utilizing the same effort as the test fill?	_____	_____
• Is the subgrade material sufficiently dry to ensure placed material can be adequately compacted to the design requirements?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-4-R
Construction Inspection
RCRA Cell Prepared Subgrade
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Is the surface graded, free of sharp rocks, debris, and other deleterious materials?	_____	_____
• Has the area been proof-rolled in accordance with the project specifications?	_____	_____
• Is the subgrade free of standing water?	_____	_____
• Has the subgrade been prepared by rolling with a smooth-drum roller?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-5-R
Construction Inspection
Geonet & Geocomposite Installation
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Has the subgrade been inspected and approved?	_____	_____
• Have the panels been installed with the high transmissivity direction in the downgradient direction?	_____	_____
• Have excessive folds or slack been removed?	_____	_____
• Have the seams been overlapped per the requirements of the specifications (4" on geonet, 6" on geotextile)?	_____	_____
• Has geonet been secured with white or yellow plastic tied at the specified spacing (5' along slope, 2' across the slope, 6' on horizontal surfaces)?	_____	_____
• Are horizontal seams lower than 1/3 of the slope height on slopes steeper than 10:1?	_____	_____
• Have all holes been repaired per the requirements of the specifications?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-6-R
Construction Inspection
Geosynthetic Clay Liner Installation
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Has the subgrade been inspected and approved?	_____	_____
• Are the panels oriented to the line of maximum slope?	_____	_____
• Have excessive folds or slack been removed?	_____	_____
• Have the seams been overlapped per the Manufacturer's recommendation?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-7-R
Construction Inspection
HDPE and LLDPE Geomembrane Installation
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Is the subgrade complete & QC/QA complete (GCL, geonet, or geocomposite)?	_____	_____
• Are the panels oriented to the line of maximum slope?	_____	_____
• Have excessive folds or slack been removed?	_____	_____
• Have the seams been overlapped per the Manufacturer's recommendation?	_____	_____
• Are bonding surfaces clean (mechanically abraded for extrusion welded Seams?	_____	_____
• Have the welding trial test seams been completed?	_____	_____
• Has the non-destructive testing been completed?	_____	_____
• Has the destructive testing been completed?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-8-R
Construction Inspection
HDPE Piping Installation
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Is the pipe bedding adequate?	_____	_____
• Has hydrostatic testing been completed on non-perforated liquid conveying pipe?	_____	_____
• Has the pipe been joined in accordance with the specifications?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-9-R
Construction Inspection
Non-woven Geotextile Installation
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Have seams been overlapped per specifications?	_____	_____
• Have seams been secured with polymeric thread or thermally bonded?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-10-R
Construction Inspection
Cover Soil Placement
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Is the material relatively homogenous soil that is free of debris, foreign objects, and sharp objects?	_____	_____
• Has the material been placed in maximum 12 inch in-place lifts?	_____	_____
• Has the minimum soil thickness listed in Specification Section 02300-3.10D been met?	_____	_____
• Has the material been generally placed in an up-slope direction for slopes steeper than three to four percent?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-11-R
Construction Inspection
Vegetative Soil Placement
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Is the material relatively homogenous soil that is free of debris, foreign objects, and sharp objects?	_____	_____
• Has the minimum soil thickness listed in Specification Section 02300-3.10D been met?	_____	_____
• Has the material been generally placed in an up-slope direction?	_____	_____

NOTES:

Signed: _____ Date: _____

ONE FORM PER SHIFT WHEN WORK IS BEING PERFORMED

FORM CQAP II-12-R
Construction Inspection
Fill Placement
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Is the soil being placed relatively homogeneous clean soil that is free of organic matter, debris, frozen material, deleterious materials and excess moisture?	_____	_____
• Has material been compacted to the minimum compaction standards?	_____	_____
• Has material been placed in accordance with lift thickness specifications?	_____	_____
• Is the subgrade material sufficiently dry to ensure placed material can be adequately compacted to the design requirements?	_____	_____

NOTES:

Signed: _____ Date: _____

FORM CQAP II-13-R
Construction Inspection
Soil Excavation and Consolidation
(Field Form)

Project Name: Malone Service Company Superfund Date: _____

Project No.: E-7888 Inspected by: _____

	YES/NO/NA	NOTE NO.
• Have excavation limits been staked?	_____	_____
• Is the material suitable for placement into the cell at the current moisture content?	_____	_____
• Has the material been placed in maximum 12-inch loose lifts?	_____	_____
• Has material been placed/compacted to the minimum compaction requirements listed in the specifications?	_____	_____
• Is the subgrade material sufficiently dry to ensure placed material can be adequately compacted to the design requirements?	_____	_____

NOTES:

Signed: _____ Date: _____

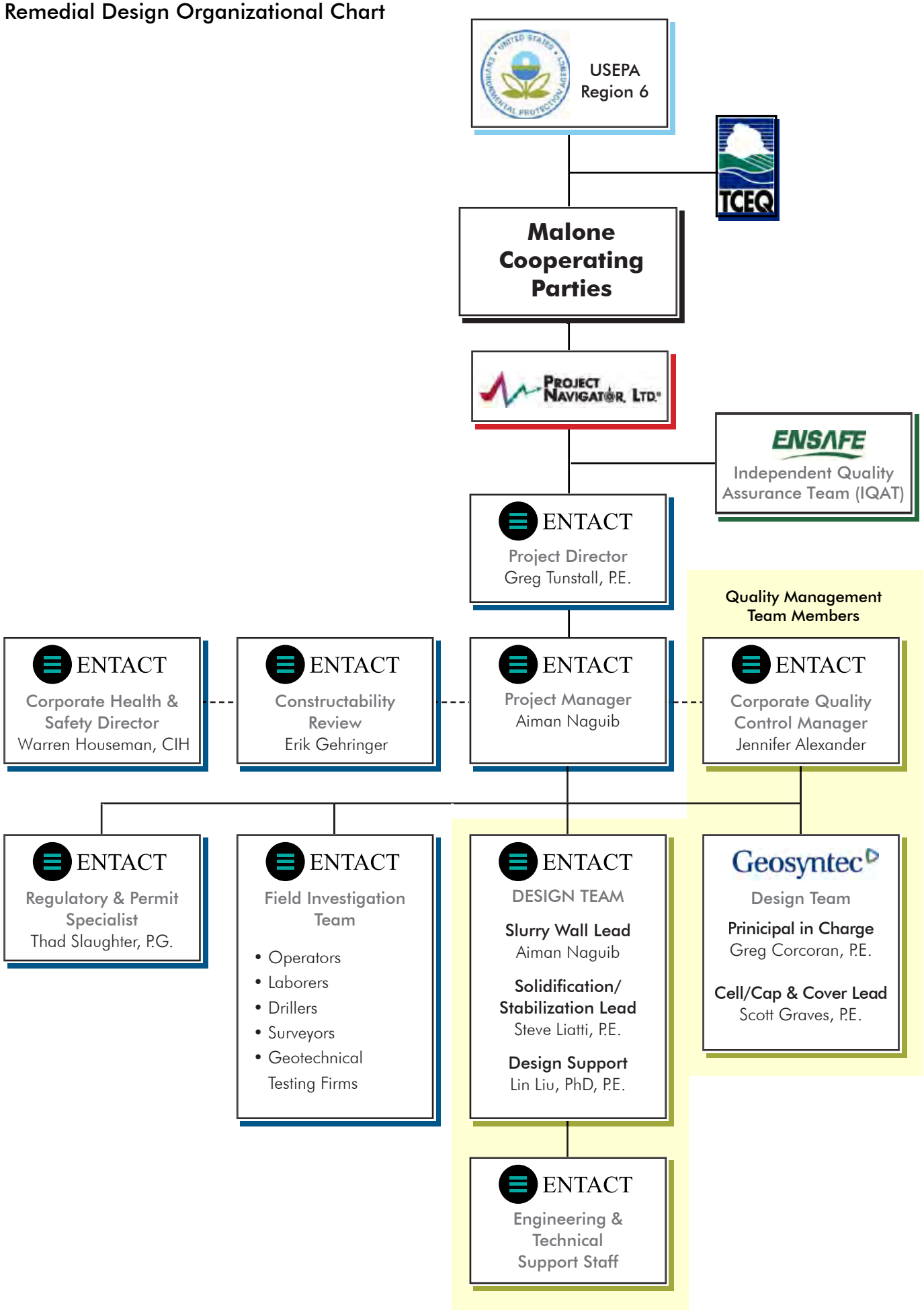
Attachments

Attachments

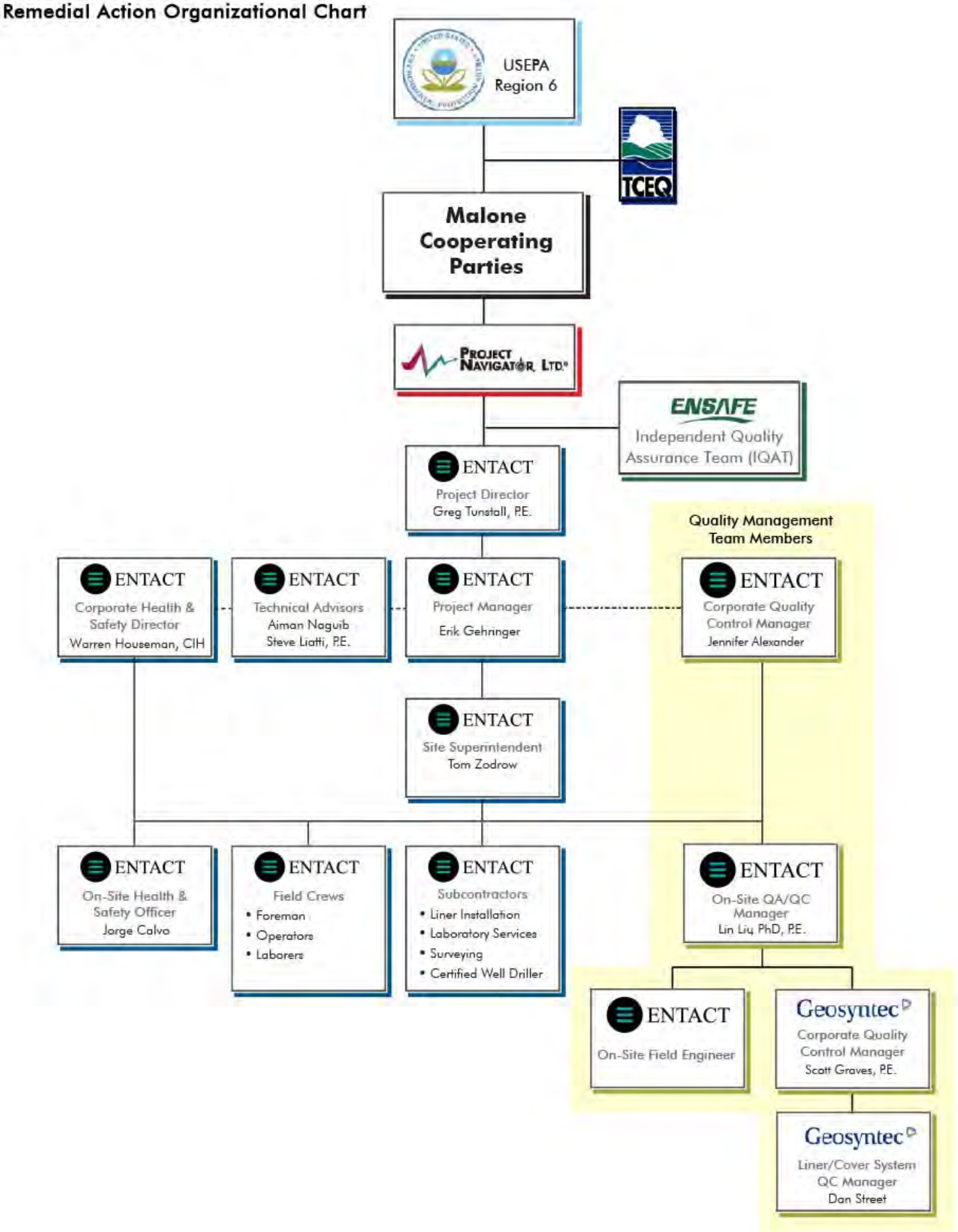
Attachment 1

Project Organization Chart

Remedial Design Organizational Chart



Remedial Action Organizational Chart



Attachment 2

Resumes

Gregory S. Tunstall, P.E.

ENTACT

Project Director

2002 - Present

Mr. Tunstall is President of ENTACT and is responsible for the overall management and successful execution of ENTACT's projects. In addition, Mr. Tunstall leads our engineering team who perform engineering services in support of our remedial construction efforts, and oversees our in-house treatability laboratory in our Houston office. Mr. Tunstall's background includes design and construction oversight, plan and budget preparation, subcontractor procurement and oversight, equipment fabrication, direct hire and union crew supervision, and overall project execution. Representative construction experience includes ground water treatment installations, landfill construction, cap/covers, stabilization/solidification, excavation/backfilling, slurry walls, demolition, dewatering, ground water collection trenching, biological treatment, dredging, cofferdam installation, wetland restoration, concrete foundation installation, steel erection, incineration, mechanical equipment and process piping installations.

ENTACT EXPERIENCE SUMMARY

Major Oil and Gas Key Supplier Program - Over 40 States
Mr. Tunstall is the Program Manager for this Key Supplier Account. ENTACT is performing remedial construction, Design/Build work, and regulatory consulting services at active and former refineries, terminals, retail sites, oilfields, and superfund sites in which activities include or have included large-scale management of organic and inorganic impacted soils, sediments and sludges, consolidation and capping, sheet pile installation, stabilization, solidification, CAMU construction, AST demolition, building decontamination and demolition, wetlands restoration, underground pipe removal, transportation and disposal, site restoration, and various other environmental and civil scopes.

Confidential NPL Site - Carlstadt, NJ
Mr. Tunstall was the Executive Sponsor overseeing this NPL Site remediation. This Site once housed a former industrial waste handling, treatment and disposal facility. Our scope of work included installation of a 600 linear foot sheet pile wall to an average depth of 42 feet along Peach Island Creek; demolition of buildings and structures; construction of a groundwater recovery system (vertical wells, horizontal headers, leachate collection tank, and building); and partial installation of a site wide cap consisting of geosynthetic clay liner, 40 mil geomembrane, geocomposite drainage layer, 18 inches of common fill, 6 inches of vegetative cover soil. To address the hot spot area, ENTACT completed a Field Verification Program (FVP) of the In-situ Air Stripping and In-situ Stabilization (ISAS/ISS) using our Delmag RH-32 Deep Soil Mixing Drill Rig equipped with an 8-foot diameter auger and 40 foot long kelley bar. The system collected emissions using a custom 10-foot diameter shroud designed and fabricated by ENTACT operating under negative pressure for collection and treatment of particulates and VOC emissions.

Industrial Complex Remediation - USEPA Region 9
Mr. Tunstall led ENTACT’s engineering efforts and is the Executive Sponsor overseeing this multi-million dollar remediation project at a 2,000 acre site at an industrial complex in Henderson, Nevada. Major scope items include the systematic blending, drying, solidification and removal of 3.7M cubic yards of waste soil, sediment and sludges; phased construction of an on-site 53-acre CAMU; concurrent placement of the amended on-site waste materials within the CAMU; installation of a RCRA Subtitle C geosynthetic/soil cover system over the CAMU; and installation of all associated storm water management features. In addition, ENTACT designed and installed a deep steel sheet pile retaining system (<50 ft bgs) to afford access for an extremely dangerous excavation of pyrophoric wastes, blended VOC's and PCB's. This particular scope was completed in Level B condition.

Due to the excessively high moisture contents of the materials to be excavated from the 16 process ponds (<20% solids), 55 dry ponds, slit trench waste (VOC's, PCB's, metals, assorted debris), and other site excavations, ENTACT conducted months of treatability evaluations to reduce the moisture levels to a target of 80% solids. This process involved extensive geotechnical evaluations, mixing, fee-draining, dewatering, and reagent evaluations of dozens of source materials. In the end, ENTACT developed a mixing regimen incorporating all of these parameters, resulting in millions of dollars of reduced costs.

Sheridan Disposal Services NPL Site - Hempstead, TX
Mr. Tunstall led ENTACT's engineering and construction activities for this Design/Build project. Activities included design and operation of a wastewater treatment plant to pump and treat over 11 million gallons of VOC-impacted water from a former process/storage lagoon; in-situ stabilization/solidification of 95,000 tons of hydrocarbon and PCB impacted sludges; treatment and disposal of stored liquids and demolition of above ground storage tanks, associated piping, and the on-site incinerator; excavation, hauling, placement, compaction and grading of over 500,000 cubic yards of site soils used to construct a landfill to contain the stabilized sludge, impacted soils, demolition debris, drums and barrels; construction of a 33-acre RCRA Subtitle C capping system; creation of a 12-acre waterfowl habitat lake from the on-site borrow area; installation of monitoring wells; and site restoration.

ISS was completed to increase bearing capacity, while reducing the leachability of the treated materials. UCS strengths averaged 40 psi, while successful SPLP leachate testing was demonstrated for metals, VOC's/SVOC's, and PCB's. A site-specific (risk-based) clean-up criteria was negotiated with U.S.EPA and TCEQ for leachability acceptance levels. ENTACT conducted the treatability study in our in-house laboratory and then proceeded with the fieldwork.

Whitehouse Waste Oil Pits NPL Site - Jacksonville, FL
Mr. Tunstall led ENTACT's engineering and construction activities for this large stabilization and remediation project in Florida. Scope of work included design and implementation of a treatability study and in-situ stabilization of 45,000 cubic yards of hydrocarbon sludges, relocation of half-mile of an existing stream away from the former waste pits by way of excavation, gabion baskets, and concrete weir construction; excavation of 10,000 cubic yards of impacted sediments from within a cypress swamp while preserving native cypress trees through careful, dental excavation; installation a 3,100 linear foot slurry wall up to 80-feet in depth around the perimeter of the site; construction of an 11.5-acre RCRA compliant capping system over the entire site, including the import and placement of over 250,000 cubic yards of clean fill, installation of 500,900 square feet of Gas Vent Geocomposite (Geonet with geotextile on both sides), Geosynthetic Clay Liner, 40-mil LLDPE liner, and Drainage Net Geocomposite (Geonet with geotextile on both sides), and topsoil; and installation of an extensive underdrain network consisting of approximately 9,000 linear feet of HDPE piping (4" and 6") which serves as a stormwater collection system, and a gas collection system which consisted of approximately 3,000 linear feet of HDPE pipe (4" diameter) which included laterals and risers.

Basin Wax Texas RRC Site - Synder, TX
Mr. Tunstall was the Project Coordinator for one of the first projects that the Railroad Commission performed utilizing treatment and on-site disposal for Exploration and Production waste, which consisted of high paraffin and oily solids that were the by product of reclamation facility operations. ENTACT completed in-situ stabilization of 20,000 cubic yards of waste; construction of a cap and cover system over the treated materials; and revegetation of the capped area that encompassed approximately 7-acres. The material for the cap and cover system was generated from an on-site borrow source that was converted into a pond for the landowner's wildlife and domestic animals.

Macalloy NPL Site - Charleston, SC
Mr. Tunstall led ENTACT's engineering and construction activities for this large-scale remediation at this former ferrochromium alloy production plant. Site activities included the excavation, transportation, and disposal of radiological debris-contaminated soil; ex-situ stabilization and chemical reduction via pugmill and pile mixing of 205,000 cubic yards of chromium VI impacted soils (covering over 50 acres); the removal and in-situ stabilization of 2,200 cubic yards of surficial sediments within a tidal marsh using swamp buggies and pontoon excavators. The marsh sediments were stabilized and treated in-situ in an on-site containment/dewatering cell constructed adjacent to the tidal marsh prior to being utilized as on-site fill and capping material. Upon completion of the marsh removal activities, a layer of geotextile and an 18-inch layer of sand were installed over the excavation area prior to an extensive re-vegetation effort to restore the impacted marsh. Additionally, 207 temporary injection wells and 20 temporary monitoring wells were installed as part of the groundwater remediation phase of the work which has effectively reduced the levels of chromium VI impacted groundwater at the site. Upon completion of remediation activities, an extensive stormwater collection and management system was installed which consisted of 5,600 lineal feet of 12" to 60" reinforced concrete conveyance pipe, 18 precast concrete structures, and two 42" water control valves. Over 5,000 lineal feet of diversion and collection canals were constructed which ultimately drained into a newly constructed 5-acre stormwater detention pond. Other activities performed on this 130-acre site included extensive clearing and grubbing, water management, construction of multiple riprap structures including permanent check dams and spillway overflow structures, and extensive site-wide grading activities. Over 100,000 cubic yards of site fill was relocated, over 46,000 tons of crushed limestone was placed, and over 125,000 cubic yards of clean fill material was imported, placed, and compacted to the

required density to achieve final site grades prior to completing site wide restoration activities. The area impacted by the dredging traffic was restored using a combination of natural regeneration, seeding and plugs of the marsh grass, and spartina alterniflora.

PREVIOUS EXPERIENCE

Exxon Bayway Sludge Lagoon Operable Unit Remediation Project - Linden, NJ
Mr. Tunstall served as Project Manager on this turnkey design/build project involving slurry wall construction, groundwater extraction trenching/piping, in-situ solidification/stabilization of lagoons, contaminated water treatment, electrical/mechanical/pumping installations, stormwater conveyance piping and swale construction, 10 acres of HDPE-lined retention basin construction, and 40 acres of low permeability soil capping and site restoration.

Shaler/JTC Soil Remediation Project - Bruin, PA
Mr. Tunstall served as Project Manager on this PADEP Superfund Project involving mechanical process design (remote concrete slurry batch plant and pumping system), demolition, asbestos abatement, off site disposal and on site consolidation of hazardous soils, in-situ solidification/stabilization of 95,000 cy of petroleum and lead-contaminated soils, followed by grading, capping, and revegetation to complete the installation of a 9-acre soil cap.

RCRA Surface Impoundment Closure, Mobil Oil Corporation - Beaumont, TX
Mr. Tunstall was responsible for daily solidification mix designs on this 500,000 CY hazardous waste project. Duties included field sampling and analysis to determine unit weight, solids content, and moisture percent used to calculate percent reagent (by weight) required to deliver desired unconfined compressive strength and permeability in a specified time frame. Other responsibilities included S/C oversight including dredging, earthwork QA/QC, surveying, demolition, asbestos abatement, and concrete placement. Additionally, Mr. Tunstall served as the field liaison with client representatives completing daily reports and maintaining several QA files for solidification (including mix location, depth, volume, UCS performance and permeability), as-built drawings and surveys, clay cap construction, and dredging.

Union Carbide Riverbank Restoration - Bound Brook, NJ
Mr. Tunstall was responsible for subcontractor oversight, surveying, geotechnical testing, planning, and supervision covering one-half mile of cofferdam construction, dewatering and irrigation system design and installation, geosynthetic riverbank stabilization, wetland re-establishment, vegetation installation, cap installation, and site landscaping. Duties included crew supervision, field engineering, QA/QC, work plan development, daily reports, as-built drawings, and engineering liaison helping with project administration, procurement, and controls.

EDUCATION

B.S., Civil Engineering - Pennsylvania State University, 1992

TRAINING AND CERTIFICATIONS

Registered Professional Engineer - State of Pennsylvania
40-Hour OSHA CFR 1910.120, with Annual Refresher
24-Hour Waste Operations Training
16-Hour Hazards & Protection Training
Loss Prevention System (LPS)
Hazardous Waste Operations Supervisor
Qualified Person, Confined Space Entry
OSHA Trenching and Excavation Safety
Primavera - Project Planning and Controls
EIT, State of California
Southeast Texas Safety Association-Refinery Safety
U.S. Department of Energy, RAD II Worker
Cal-OSHA Excavation Trenching Competent Person
Mining Safety and Health Administration (MSHA)

Jennifer L. Alexander

ENTACT

PROJECT COORDINATOR SPECIAL PROJECTS PROGRAM MANAGER
CORPORATE QUALITY CONTROL DIRECTOR

1992 -Present

Ms. Alexander has nearly twenty years of consulting and project management experience in a broad range of environmental areas and coordinates the efforts of our technical and quality assurance groups within the company. Her project experience includes project management, environmental consulting and assessments, coordination of field remediation activities, quality assurance/quality control, job cost oversight, customer/regulatory relations, and maintaining health and safety objectives. Ms. Alexander is well versed in Voluntary Cleanup Programs and has assisted many clients with real estate transactions for Brownfields properties and specializes in liability/asset transfer of grouped properties. She has also developed and written state and federal regulatory documentation for site closures, work plans, quality assurance project plans, and sampling and analysis plans. Ms. Alexander has also designed and implemented passive groundwater treatment technologies to address hexavalent chromium and chlorinated solvents concentrations at numerous sites.

ENTACT PROJECT EXPERIENCE

Halliburton Energy Services Portfolio - Closure of 53 Sites
Various Sites in the U.S., Canada, and Select Worldwide Locations Ms. Alexander is the Program Manager for this 7 year contract for the remediation of soil and groundwater at 53 sites worldwide. This program requires management of regulatory, landowner, adjacent landowner, and closure issues in various countries and states. Ms. Alexander is responsible for overall management of the project team and contract issues, project management, treatment design, regulatory interaction, reporting, cost tracking, environmental insurance, and scheduling efforts for the program.

Imperial Sugar Refining Site - Sugarland, TX
Ms. Alexander is the Project Coordinator for Phase I due diligence efforts at this 7,000-acre former sugar refining site in preparation for sale and redevelopment.

Beazer East, Inc. - Pittsburgh, PA
Ms. Alexander is the Project Manager for soil and groundwater remediation for chrome plating facilities in Texas and Colorado. Sites include groundwater management and treatment of hexavalent chromium plumes. In-situ geochemical treatment and enhanced natural attenuation has been implemented for both sites to minimize risk in a cost effective manner. Ms. Alexander is responsible for work plan development and approval, management of all field tasks, interaction with regulatory agencies, consulting, and final project reporting to obtain closure.

City of Austin, Mabel Davis Landfill Project - Austin, TX
Ms. Alexander was the Project Coordinator and Agronomy Consultant during the final stages of implementation of this 26-acre landfill construction project that was ultimately redeveloped into a public park. The landfill redevelopment project involved extensive planning, coordination, engineering, construction, and landscaping requirements. Ms. Alexander assisted the field project team and City of Austin in project coordination, vegetation issues, site inspections, and final project closeout tasks.

Juncos Landfill Superfund Site - Juncos, Puerto Rico
Ms. Alexander was the Project Coordinator and Agronomy Consultant during the final stages of implementation of this 18-acre landfill construction project. Ms. Alexander coordinated and conducted site inspections, meetings, field activities with the USEPA, USACE, Housing Authority, PR Environmental Quality Board, PRP Group, local government, and other parties.

Wortham Lead Salvaging Superfund Site - Mabank, TX
Ms. Alexander was the Project Manager for remediation of this Superfund Site. Project activities included soil and battery casing removal, on-site stabilization, off-site disposal, extensive verification sampling, pond and sediment sampling, and site restoration. These activities were performed under stringent quality assurance and quality control

procedures. Responsibilities included all field tasks, project plan development, interaction with regulatory agencies, consulting, and final project reporting to obtain closure.

Eagle Mine Superfund Site - Minturn, CO
Ms. Alexander was the Project Coordinator at this Superfund Site, formerly the largest zinc mine the world. Site activities included removal, decontamination, abatement, and remediation of mine concentrate material from the Belden Buildings. Removed materials were consolidated in an on-site landfill and restored. Responsibilities included oversight consulting communications, regulatory interaction, coordination of project activities, landfill restoration, sampling, scope of work compliance, and project reporting.

Universal Foods - Dallas, TX
Ms. Alexander was the Project Coordinator for the remediation of a former battery manufacturing operation and surrounding railroad areas. Project tasks included demolition of 120,000 square feet of concrete slab, excavation of 12,000 cubic yards of contaminated soils, debris and battery components, decontamination and dismantling of 750 feet of railroad track, on-site stabilization of 6,500 cubic yards of excavated material, and off-site transportation and disposal. Responsibilities included implementation of all field tasks, field sampling, site air monitoring and project reporting.

INCO United States, Inc. - Wrightsville Beach, NC
Ms. Alexander was the Environmental Consultant and Project Manager for this project which included the removal of a pesticide impacted landfill from a former flower nursery. Site activities included a pesticide investigation, road construction, deforesting, the removal of 4,700 cubic yards of debris from the landfill, and site restoration. Responsibilities included implementation of all field tasks, project management, interaction with regulatory agencies, consulting, project reporting, and final site closure.

Dallas Gun Club - Las Colinas, TX
Ms. Alexander was the Environmental Consultant and Project Coordinator for the project which included the removal of 20,000 cubic yards of lead impacted soil to background concentrations. The project was completed ahead of schedule under the Voluntary Cleanup Program for commercial use. Responsibilities included coordination and management of field activities, interaction with regulatory agencies, project reporting, and site closure.

Fojtasek Companies - Dallas, TX
Ms. Alexander was the Environmental Consultant who assisted our customer with the preparation of multiple property transfers of active manufacturing plants for an impending real estate transaction. A group of properties were entered into the Voluntary Cleanup Program in preparation for the transaction with subsequent assessment, investigation, remediation, and closure. Ms. Alexander conducted all aspects of the regulatory interface, reporting, and field activities.

EDUCATION

B.S., Industrial Engineering Technology, University of North Texas - Denton

TRAINING AND CERTIFICATIONS

OSHA 40-Hour HAZWOPER Training OSHA
8-Hour Annual Refresher
Nuclear Gauge Safety
RCRA Fundamentals Advanced RCRA Topics RCRA Land Disposal Restrictions Petroleum Storage Tank Corrective Action Specialist Lead Awareness and Worker LPS Behavior Based Safety Training Avoiding Mistakes in Waste Identification

Aiman Naguib

ENTACT

REMEDIAL DESIGN: PRJOECT MANAGER, SLURRY WALL LEAD
REMEDIAL ACTION: TECHNICAL ADVISOR
2008 - Present

Mr. Naguib has over twenty years of experience in general remediation, specialty environmental, and geotechnical construction, with over sixteen years in the management and supervisory roles. At ENTACT, Mr. Naguib is responsible for proposal development and review, development and execution of approved project work plans, field operations, and personnel and field resource allocation for his projects. In addition, he has worked extensively as a technical advisor and project manager on complex geotechnical projects involving slurry wall construction, PRB wall construction, and cap construction. He has personally been responsible for construction of 37 slurry walls around the county – 5 of which were Design/Build. Most significantly, Mr. Naguib has particularly extensive and specialized expertise in the area of in-situ solidification and stabilization (ISS), having successfully treated millions of tons of impacted materials. His In-situ solidification/stabilization experience includes the development and implementation of numerous challenging on-site remedies for in-situ SS projects with metals contamination (lead, arsenic, chromium), as well as organics (petroleum hydrocarbons, NAPL, etc.). This work has included the use of backhoes, horizontal augers, specialty augers, and vertical deep soil mixers. Mr. Naguib's technical expertise is recognized throughout the industry and includes treatability studies and mix design programs using proprietary additives as well as more common applications (e.g. Portland Cement, bentonite, etc.) to treat contaminated soils, sludges, and sediments an effort to control valence states, buffer pHs, increase bearing capacities, reduce leachability, reduce permeability, prevent durability impacts, and remove the ability to produce a visible sheen on a multitude of contaminated soils.

ENTACT EXPERIENCE SUMMARY

Former Ciba Facility Slurry Wall and Cap Construction OU2 - Toms River, NJ
Mr. Naguib is the Slurry Wall Specialist responsible for slurry wall installation at this site. Scope of work includes construction of three separate soil bentonite slurry walls around the perimeter of perched water management areas totaling 6,074 feet in length, 3 feet in width, and 17 to 45 feet in depth, meeting a permeability of not greater than 1 x 10-6 cm/s. Cap construction consists GCL or gemembrane, drainage layer, geotextile, and topsoil. Other activities include construction of stormwater systems, drainage swales, and revegetation.

Active Refinery – MS
Mr. Naguib serves as a Project Coordinator and Technical Advisor for various phases of work related to the refinery's capital expansion program. Highlighted projects are outlined below:

Tank Pads – Scope of work includes subsurface ground improvement measures at 16 proposed tank footprints to minimize the potential for future tank foundations settlement. Scope of work includes installing a series of soil-cement columns underneath the planned footprint of each tank foundation. ENTACT is employing (2) In-Situ Vertical Auger Mixing Rigs complete with their respective Grout Batch Plants that will work concurrently in order to accomplish the specified work within the allotted durations. Mr. Naguib designed and implemented a series of treatability studies at our in-house laboratory to determine the optimum reagent and delivery program required to meet project objectives and performance criteria.

ISS Soil Remediation Project – This project involves in-situ solidification/stabilization (ISS) of impacted soils located in a former SMWU where construction of an Isodewaxing Process Unit (IDW) is planned as part of this refinery's capital expansion program. Specific scope of work includes ISS of approximately 86,000 cubic yards of low pH impacted soil up to 18 feet bgs to achieve a pH of greater than or equal to 6.0, pass TCLP for metals, achieve minimum UCS of 21 psi in 28 days, meet a permeability of 1 x 10^{-7} cm/sec or less along a 3-foot wide minimum corridor of the outer perimeter of the treatment area (barrier wall) and 1 x 10^{-6} cm/sec or less for the interior. Additionally, the treated soil's wet/dry durability must not exceed 10% of initial mass loss after 30 days. ISS is being accomplished utilizing a combination of granulated ground blast furnace slag (GGBFS) and Portland cement delivered by ENTACT's vertical auger mixing rig (Delmag RH-32) equipped with a 10-foot diameter auger and a containment shroud to capture potential off-gas and/or odor and its respective batch plant configuration. Additional scope includes transportation and placement of generated spoils in an on-site surge pond.

Sydney Tar Ponds - Novia Scotia, Canada
Mr. Naguib is the Geotechnical Lead responsible for stabilization/solidification aspects of this tar ponds closure project in Canada. ENTACT is providing Solidification/Stabilization Technical Assistance to our Canadian Joint Venture Partner, Nordlys, for the Sydney Tar Ponds project in Nova Scotia. ENTACT performed the Solidification/Stabilization mix designs in its Houston treatability lab, as well as provided assistance to Nordlys in proposal preparation, cost estimating and completion of required submittals. The Solidification/Stabilization field pilot program was completed in late 2009. Work will be completed in consecutive phases over the next 3 years, with Phase I completed in 2010. During the construction phase, ENTACT provides Solidification/Stabilization supervision personnel and quality control officers (total of 10 individuals) to oversee the work. Scope includes solidification/stabilization of approximately 570,000 cubic meters of impacted sediment, with treated sediment being required to achieve permeability less than 1 x 10-6 cm/sec, minimum unconfined compressive strength of 25 psi and achieve modified leachability limits specific to this project.

Former Terminal - Buffalo, NY
Mr. Naguib was the Project Coordinator and Technical Advisor overseeing this project. ENTACT completed excavation of a series of exploratory and sampling test pits for ExxonMobil at this former terminal. Scope also included performing field pilot studies to evaluate the potential viability of full scale remediation using Bioremediation and/or Chemical Oxidation through in-situ mixing of nitrates and oxidizing agents into a series of 30-foot by 30-foot test areas. Additionally, ENTACT collected samples and conducted bench scale treatability testing at our in-house laboratory. Based on the sucessful results obtained from bench scale testing, ENTACT re-mobilized to the site and conducted an additional field pilot program to field-verify the treatability study findings with regards to treatment of lead-impacted and grossly-impacted waste. Field pilot treatment was conducted within four 20-foot by 20-foot test plots.

Gas Plant Sludge Pit Closures - Garden City, LA
Mr. Naguib was the Project Coordinator for this gas plant sludge pit closure project. Scope of work included site preparation; clearing and grubbing of a significant amount of vegetation; access road construction; demolition and removal of above ground piping; dewatering, treatment and discharge of 625,500 gallons of water; and excavation of TPH impacted sludge up to 5 feet below potentiometric ground water surface. A total of 11,394 tons of excavated material was solidified with fly ash to meet Type 12 - Non Hazardous Natural Gas Processing Waste Solid, and loaded and transported to the client designated landfill. Additional activities include placement of approximately 15,000 cubic yards of imported backfill, final site grading, and revegetation of disturbed areas with a mix of native grasses.

Confidential NPL Site - Carlstadt, NJ
Mr. Naguib was the ISAS/ISS Specialist responsible for the successful completion of the in-situ air stripping (ISAS) and in-situ stabilization/solidification (ISS) portion of this project. This Site once housed a former industrial waste handling, treatment and disposal facility. Our scope of work included installation of a 600 linear foot sheet pile wall to an average depth of 42 feet along Peach Island Creek; demolition of buildings and structures; construction of a groundwater recovery system (vertical wells, horizontal headers, leachate collection tank, and building); and partial installation of a site wide cap consisting of geosynthetic clay liner, 40 mil geomembrane, geocomposite drainage layer, 18 inches of common fill, 6 inches of vegetative cover soil. To address the hot spot area, ENTACT completed a Field Verification Program (FVP) of the In-situ Air Stripping and In-situ Stabilization (ISAS/ISS) using our Delmag RH-32 Deep Soil Mixing Drill Rig equipped with an 8-foot diameter auger and 40 foot long kelley bar. The system collected emissions using a custom 10-foot diameter shroud designed and fabricated by ENTACT operating under negative pressure for collection and treatment of particulates and VOC emissions.

RELEVANT EXPERIENCE

Bechtel Jacobs Joint Venture BathTub Excavation - Port Arthur, TX
Mr. Naguib was the Executive Sponsor for the excavation and stabilization (bathtubbing) of the DCU2 and VPS5 areas known as the "Early Works". Excavated spoils were transported, deposited, mixed, spread, and compacted in specified locations in the plant. Removal of existing plant utilities, piping, foundations and pilings was necessary to complete the excavations. Soil stabilization utilizing crushed limestone was installed on the bottoms and perimeter drainage ditches were installed to design elevations for future pile driving operations. These areas were prepared for future construction as part of the refinery expansion.

Port Arthur Refinery Reservoir 5 Project - Port Arthur, TX
Mr. Naguib was the Executive Sponsor responsible for overseeing the remediation services for the removal and closure impoundments within this refinery. Scope of work included solidification, excavation, and

removal of approximately 450,000 cubic yards petroleum-contaminated soils/sludges to the average depth of 8 to 9 feet from an existing 23.5-acre impoundment area. In addition, scope included solidification of approximately 700,000 cubic yards of petroleum impacted soils/sludges within a 33-acre impoundment area. Final cap construction consisted of 18-inches of compacted clay and 6-inch stone cap over the 33-acre area.

WE Energies West Side MGP Site - Milwaukee, WI
Mr. Naguib was the Project Manager responsible for Phase II remedial operations that consisted of treating two areas of the West Side former MGP site using in-situ stabilization/solidification (ISS). The total estimated volume of MGP impacted material treated was approximately 25,000 cubic yards. Mr. Naguib managed all ISS operations which were conducted by mixing MGP impacted materials with an engineered mix of Portland cement and ground granular blast furnace slag (GGBFS) up to depths of approximately 25 feet below ground surface to encapsulate MGP residuals and render them inert.

Aggregate Industries - Brighton Mine Slurry Wall - Adams County, CO
Mr. Naguib was the Executive Sponsor overseeing the construction of 15,475 lineal feet of soil-bentonite slurry wall with an average depth of 31.0 feet. The slurry wall was keyed a maximum of 6.0 feet into the underlying bedrock and had a maximum permeability of 1.0×10^{-7} cm/sec. A mounding cap consisting of surplus soils/spoils was placed over the completed wall.

Georgia Power - Former Columbus MGP Site - Columbus, GA
Mr. Naguib was the Project Manager for this MGP site remediation. Scope of work included site investigation, design preparation and in-situ stabilization of over 80,000 cubic yards of Coal Tar contaminated soils in a 15-foot thick zone located under 10-20 ft of miscellaneous fill. Work was performed directly adjacent to a river, within tight space constraints. Upon completion of ISS, an impermeable cap was placed over the stabilized material and the site turned into a new park.

Former MGP Site - Augusta, GA
Mr. Naguib was the Technical Advisor for this MGP site remediation. Scope of work included excavation and off-site disposal of over 100,000 tons of MGP impacted material, in situ stabilization (ISS) of over 72,000 cubic yards of MGP impacted materials, canal dredging, and restoration. A portion of the work at the site was completed within a temporary enclosure with air filtering system to minimize odors and emissions.

Suburban Ready Mix, Inc - Gravel Pit Slurry Cutoff Wall Design and Construction - Fort Lupton, CO
Mr. Naguib was the Executive Sponsor for the design and construction of a cutoff wall that was 30-inches in width, and 9,050 feet long with a fascial area of approximately 339,675 square feet. The walls depths ranged from 25 to 59 feet and were constructed to create a surface water storage reservoir and eliminate dewatering efforts of the gravel pit to facilitate future and current mining operations. Cutoff wall excavation was installed through an overburden clay layer, underlying sand and gravel layer and keyed 3.0 to 5.0 feet into the underlying Denver Bedrock formation, meeting the design performance criteria of 1×10^{-7} cm/sec range. Soil-Bentonite backfill consisted of suitable excavated soils, bentonite slurry and the addition of dry bentonite (as needed) to excavated soils. Cutoff wall excavation was done utilizing an Extended-Arm Komatsu PC-750 Hydraulic Excavator equipped with a Rock Ripper Bucket capable of reaching depths of 58-feet with Bentonite Slurry.

Motiva Enterprises - Drainage Ditch #7 Slurry Wall - Port Arthur, TX
Mr. Naguib was the Project Sponsor for the construction of 1,450 lineal feet of a soil-bentonite slurry cutoff wall to an average depth of 8 feet, meeting the permeability performance of 1×10^{-7} cm/sec. Work included daily QC testing and permeability testing by a third-party laboratory as well as a cap of surplus soils/spoils and site restoration.

WE Energies - Racine MGP Site - Milwaukee, WI
Mr. Naguib was the Project Manager for this MGP site remediation. Scope of work included excavation, stockpiling of overburden material, in-situ stabilization/solidification (ISS) of approximately 6,000 cubic yards of soil, backfilling, site grading, material management and hauling of MGP-affected debris and excess overburden soil for disposal.

L-2 Landfill Cap - Port Arthur, TX
Mr. Naguib was the Executive Sponsor who provided technical oversight for the construction of a compacted clay landfill cap for the closure of a former 22-acre Class II nonhazardous waste landfill.

SI-4 Sludge Solidification - Port Arthur, TX
Mr. Naguib was the Executive Sponsor who provided direct technical, administrative, financial, and operational oversight for the solidification, excavation, and removal of petroleum-contaminated soils and sludge from an existing sludge impoundment (SI-4) at this refinery. Sludge/soils located in the designated area were mixed with reagents for solidification in order to facilitate the transportation to the on-site HDPE-lined CAMU for subsequent disposal. Sludges met the project performance criteria to pass paint filter testing and an unconfined compressive strength capable of supporting equipment for the future closure of the CAMU.

Sunoco Solid Waste Management Unit (SWMU) Number 5 - Tulsa, OK
Mr. Naguib was the Project Manager/Project Sponsor/Technical Advisor for this SWMU remediation. Scope of work included excavation of 6,400 CY of refinery waste from the Arkansas River and 3,400 CY waste from the river bank and other areas; consolidation of the waste in an on-site cell; armoring of the riverbank with 24-inch rip rap; and capping the 8.6 acre with a 2-foot cover system. Mr. Naguib also developed and oversaw the installation of a unique 11 ft. wide x 800 ft long rip rap bench in the river at the base of bluff along the river.

McCommas Bluff Landfill Levee and Swale Construction, Slurry Wall Construction - Dallas, TX
Mr. Naguib was the Project Sponsor/Technical Advisor for the installation of a soil-bentonite slurry wall below a future Levee System. As Technical Advisor, Mr. Naguib determined that the cutoff wall construction was necessary to facilitate existing landfill expansion. The soil-bentonite slurry cutoff wall had a facial area of 527,830 square feet with a depth ranging from 26 feet to 62 feet and a width of 3.0 feet. Cutoff wall excavation material consisted of inter-bedded layers of silty clay and silty sand with a 3.0-foot Limestone key. Backfill material consisted of a mixture of suitable excavated soils and Bentonite Slurry. Mr. Naguib ensured that the slurry wall performance criteria of 1×10^{-7} cm/sec or less was met.

Material Recovery Resources Superfund Site, Solidification and Site Remediation - Ovalo, TX
Mr. Naguib was the Project Sponsor/Technical Advisor for site closure of the former Intercontinental Ballistic Missile Silo that was used as a Class I industrial solid waste facility. Mr. Naguib provided technical and operational oversight for the solidification of approximately 686,550 gallons of impacted water within the silo, the removal of two impoundment ponds, removal of an irrigation area, demolition of existing above ground structures, site backfilling, re-grading and final site restoration. Solidified water, soils and debris were placed back into the silo to serve as the final closure of the site.

Chemical Waste Management (CWM) Soil Bentonite Slurry Cutoff Wall - Sulphur, LA
Mr. Naguib was the Project Manager/ Project Sponsor/Technical Advisor for the construction of a soil-bentonite slurry cutoff wall which was constructed along a prepared work platform along the footprint of the proposed hazardous waste cell expansion. The slurry wall was approximately 7,400 feet in length with the maximum depth of 47 feet and an average depth of 42 feet. The newly constructed slurry wall tied into an existing slurry wall of an adjacent cell.

AGVIQ - CH2M Hill (Joint Venture)/U.S. Navy - Camp Lejeune, NA
Mr. Naguib was the Project Manager/Sponsor/Technical Advisor for this single auger soil mixing project consisting of injecting and in-situ mixing 2% zero valent iron and 1% bentonite to impacted soil by weight using in-situ vertical auger mixing technology. A total of 7,052 cubic yards of soil was treated to a depth of 20 feet.

The Broadmoor Hotel, Inc.'s Mountain Golf Course Vertical Drain Walls - Colorado Springs, CO
Mr. Naguib was the Project Sponsor/Technical Advisor for the construction of four biopolymer vertical drain walls at this Golf Course. Mr. Naguib provided technical and engineering oversight for the installation of the vertical drains walls which were 2.5 feet wide and 40 feet deep with a total fascial area of 125,000 square feet. A total of five outfall turnouts were installed and connected to the drain systems for collected water conveyance.

Permeable Reactive Barrier, SWMU 12 at Naval Weapons Station - Charleston, SC
Mr. Naguib was the Project Manager/Project Sponsor/Technical Advisor for the construction of an iron filings permeable reactive barrier (PRB) which was 130 feet long and 3 feet wide with maximum depth of 40 feet. Trench excavation was done using a biodegradable biopolymer slurry. Mr. Naguib determined that two treatment media types, including pure zero-valent iron and sand iron, were necessary to backfill the PRB to meet performance standards. Other responsibilities included waste characterization for liquid and soil on-site and of f-site disposal.

Kelly USA PRB Installation using Biopolymer Slurry Method - San Antonio, TX
Mr. Naguib was the Project Sponsor/Technical Advisor for the Construction of a PRB wall which was approximately 650 feet long with an average depth of 38 feet. The PRB was composed of various sand-iron treatment media blends that ranged from 45 to 90 iron aggregate.

WE Energies - Former Manufactured Gas Plant (MGP) Site - Appleton, WI
Mr. Naguib was the Project Manager/Project Sponsor/Technical Advisor for the treatment of 40,000 cubic yards of former MGP waste via in-situ single auger mixing for stabilization/solidification. Mr. Naguib developed the in-situ stabilization strategies and performed bench scale confirmation testing, stabilization of 1,700 cubic yards of riverbank soils using excavator-mounted injectors, and odor/water control/ management.

ExxonMobil - ElectroPhos Site - Mulberry, FL
Mr. Naguib was the Project Manager for the closure of a 45-acre former Phosphate Mine which included the installation of a RCRA cap and a soil-bentonite slurry cutoff wall to contain phossy material.

US EPA Frontier Hard Chrome Superfund Site - Vancouver, WA
Mr. Naguib was the Project Manager for remediation of this Superfund site. Scope of work included treatment and solidification of 22,000 cubic yards of hexavalent chrome-contaminated soil to a depth of 33 feet. In-situ treatment was performed using a combination of a 10-foot and 6-foot diameter auger. Mr. Naguib oversaw the soil treatment, which consisted of injecting ECOBOND to convert the hexavalent chrome to trivalent chrome. This was followed by injection of cement-based grout to solidify the treated soil. Other responsibilities included pre-trenching for soil/debris screening as well as off-site disposal of soil, fluff and debris.

Morton Arboretum - Meadow Lake Improvements Slurry Wall - Lisle, IL
Mr. Naguib was the Project Sponsor for the construction of a soil-bentonite slurry wall which was installed to create a lake and eliminate water seepage from migrating outside the lake limits. The cutoff wall was 3 feet wide and 24 to 47 feet deep with a fascial area of 97,799 SF. Mr. Naguib also oversaw the required earthwork for work platform construction, wetlands restoration, and final site grading.

L.G. Everist's Fort Lupton Gravel Pit Slurry Cutoff Wall Reconstruction and Repairs - Fort Lupton, CO
Mr. Naguib was the Project Sponsor for the design and construction of a soil-bentonite slurry cutoff wall which was 30 inches wide and 7,700 feet long with a fascial area of 291,000 SF. The cutoff wall ranged in depth from 25 to 57 feet and was constructed to create a water storage reservoir while eliminating dewatering for gravel pit.

DeLuge Basin Treatment - Cape Canaveral, FL
Mr. Naguib was the Project Manager for this in-situ auger mixing project using a 7-foot-diameter auger that was performed from a depth of 10 feet to 55 feet at the Launch Complex and from a depth of 20 feet to 45 feet at the Deluge Basin. A total of 37 columns were treated using hot air and steam (at 160° F) injection. Upon treatment with hot air and steam, some of the columns were further injected (as a polishing step) with Connelly GPM zero-valent iron filings (addition rates ranging from 1.0% to 2.5% to soil by weight); Peerless zero-valent iron filings (addition rates ranging from 1.0% to 2.5% to soil by weight); and NASA's emulsified zero-valent iron. All off gassing generated during the treatment work was collected under a shroud and treated through vapor-phase granular-activated carbon.

Former MGP Site - Macon, GA
Mr. Naguib was the Project Manager/Technical Advisor for the remediation of a 5-acre MGP site which included ex-situ and in-situ soil treatment as well as off-site removal/disposal of approximately 150,000 tons of contaminated soil, concrete, and debris. The off-site removal/disposal work included demolition, excavation, and off-site transportation of approximately 90,000 tons of coal tar-contaminated soil, concrete, and debris to a Subtitle D landfill. Mr. Naguib also provided technical oversight for the ex-situ treatment of soils, including conditioning approximately 5,000 tons of tar and tar-like materials with soil and quicklime. Mr. Naguib was responsible for in-situ stabilization of 55,000 tons of contaminated soils below the groundwater table using a 12-foot-diameter mixing/injection tool and cement-slag-based grout.

Conoco, Inc. and Colorado Refining Company Sand Creek Slurry Wall - Commerce City, CO
Mr. Naguib was the Project Sponsor for the construction of a soil-bentonite slurry cutoff wall which was approximately 2,400 feet in length with the maximum depth of 35 feet and an average depth of 23 feet. The backfill for the slurry wall included a mixture of slurry and dry bentonite to achieve a total of 6% bentonite

addition to the excavated soils. Mr. Naguib also provided oversight of the site's restoration, which included the construction of a site access road, wetlands mitigation, seeding, and planting along Sand Creek.

Former Shore Refinery Removal Action - Kilgore, TX
Mr. Naguib was the Project Sponsor for managing the excavation and removal of petroleum-contaminated soils, sediment, vessels, and debris from a former waste oil processing facility. The removal action included the excavation and stabilization of approximately 9,000 cubic yards of impacted soils, sediment, and debris using Level B protocols. Mr. Naguib was responsible for the demolition and removal of an API separator and removal/stabilization of sediments from a pond. He also oversaw the dismantling and decontamination of two on-site vessels. Soils and sediments were stabilized with fluidized bed ash prior to transportation to a Class 1 disposal facility in North Texas.

HWL, Cell 2 Geotechnical Liner Construction, Rocky Mountain Arsenal - Commerce City, CO
Mr. Naguib was the Project Sponsor for the construction of a Subtitle "C" hazardous waste landfill which included the installation of a double-lined composite liner system for a 12-acre cell (Cell 2) expansion. Landfill construction included installing secondary and primary liner systems complete with leachate collection and detection systems.

Complex Trenches and Shell Section 36 Trenches, Rocky Mountain Arsenal - Commerce City, CO
Mr. Naguib was the Project Manager for the construction of two groundwater cutoff barriers at a site. Due to the possibility/risk of encountering highly contaminated soils and/or unexploded ordinances (UXOs), Mr. Naguib developed a design that included utilizing in-situ deep soil mixing. He determined that the inherent engineering features of the in-situ deep soil mixing would control the risk of volatilizing the soils during the mixing process. All intrusive work was performed using Level B protection due to the volatile nature of the site. A total of approximately 178,800 square feet of soil-impermix groundwater barriers were installed. These barriers ranged in depth from 15.0 feet to 37.0 feet with a total length of 7,346 feet.

Groundwater Recovery Trench, Rocky Mountain Arsenal - Commerce City, CO
Mr. Naguib was the Project Manager for the installation of a groundwater recovery trench using the single-pass trencher method. Mr. Naguib determined that the initial design was not feasible due to the instability of indigenous silty sand, which could not be supported by the trencher's built in shoring system. He assisted the client in redeveloping the engineering approach to facilitate the design and installation of the proposed collection trench utilizing the biopolymer (BP) technology. The redeveloped design included the construction of the 200 LF of trench utilizing BP. The trench had a minimum width of 30 inches and a depth of 22 feet. Spoils and soil excavated from the trench were mixed with residual degraded BP slurry and stockpiled alongside the edge of the work platform. An 8-inch-diameter stainless steel well and horizontal drainpipe were installed within the trench to serve as the extraction system.

Amoco Oil Refinery, Storm Water Sludge Basins Closure - Whiting, IN
Mr. Naguib was the Project Manager for the remediation and closure of five stormwater sludge basins at this active refinery. Scope of work included construction of a 44,000-SF cement-bentonite slurry cutoff wall that overlapped a 46,000-SF jet grout wall, creating a groundwater barrier for containing hydrocarbon-contaminated sludge and soil, stabilization of approximately 110,000 cubic yards of API separator sludge utilizing in-situ shallow soil mixing (SSM) and backhoe mixing, installation of a double-layered clay cap, multilayered geosynthetic liner system, gradient control dewatering wells, and leachate collection system complete with drainage sumps.

USACOE Kane and Lombard Superfund Site - Baltimore, MD
Mr. Naguib was the Quality Control Manager for the RCRA closure of a formerly un-permitted 8-acre landfill. Mr. Naguib provided engineering oversight for the construction of a 48,500 SF soil-bentonite slurry cutoff wall, composite liner system that utilized 2 feet of compacted clay cap and multi-layered geosynthetic membrane liner complete with a leachate collection system. He also provided engineering controls for the installation of a series of extraction and monitoring wells.

Rockingham County Landfill- Cells 1 to 3 - Wentworth, NC
Mr. Naguib was the Project Manager for the construction of a new 16-acre Subtitle D landfill which included excavation and backfilling of approximately 800,000 cubic yards of soil, installation of pugmill blended soil-bentonite liner, multi-layered geosynthetic liner, leachate collection system, stormwater drainage system, and concrete paved road around the newly constructed landfill.

City of Odessa Subtitle "D" Landfill Construction - Odessa, TX
Mr. Naguib was the Project Manager for the construction of a new 6-acre Subtitle D landfill that included managing the rock excavation, subgrade preparation, installation of 300,000 SF of composite multilayered liner system, and leachate collection system.

Albemarle Corporation - Groundwater Collection Trench - Magnolia, AR
Mr. Naguib was the Project Manager for the design and construction of a groundwater collection/barrier wall system to eliminate potentially contaminated groundwater from migrating into an existing wetland area and facilitate groundwater extraction for treatment. Mr. Naguib was responsible for clearing, grubbing, work platform construction, leachate interceptor trench/barrier wall construction, and site restoration. The constructed wall system consisted of two 30-inch-wide trench segments, 1,200 feet in length. The two segments had a fascial area of 24,720 SF with depths ranging from 15 to 25 ft. Each segment was equipped with a 48-inch-diameter HDPE sump and clean out. Sumps and clean-outs were hydraulically connected through a horizontal 4-inch-diameter perforated HDPE drainage pipe wrapped with woven geotextile fabric installed along the trench bottom. Mr. Naguib provided construction oversight for the liner system installation, which was constructed along the down gradient side of the trench. The system consisted of a series of 80 mil HDPE interlocking panels with hypertite sealant installed at the interlocks. The trench was backfilled with washed concrete sand and capped with non-woven geotextile fabric and 2 ft of soil cover.

Zenith Tech - Retaining/Cutoff Walls Installation - Milwaukee, WI
Mr. Naguib was the Project Manager responsible for the design and construction of approximately 220,000 SF of steel-reinforced soil-cement-bentonite retaining/cutoff walls using in-situ deep soil mixing. Retaining/cutoff walls varied in depth from 30 to 60 ft. Mr. Naguib designed the walls to facilitate the excavation and construction of a depressed roadway for separating rail traffic from normal vehicle traffic. He was also responsible for jet grouting around utilities penetrating the soil-mixed walls and miscellaneous earthwork including removal and restoration of railroad tracks in areas where tracks intersected DSM walls.

Subsurface Soil Improvement using In-situ Auger Mixing - Honolulu, HI
Mr. Naguib was the Project Manager for the design and construction of a subsurface soil improvement system utilizing shallow soil mixing (SSM). Mr. Naguib determined that SSM was required to reduce settlement, improve structural bearing capacity, and reduce liquefaction potential of in-situ soils to facilitate construction of aboveground fuel storage tanks over soft saturated soils. Responsibilities included designing and installing a total of 185 soil-cement columns, 6 feet in diameter, 12 feet deep underneath three proposed tank foundation rings. Soil-cement columns constructed on 11-foot centers with columns staggered in adjacent rows. He ensured that soil-cement spoils generated during SSM were mixed with additional cement grout to construct a 2-foot-thick soil-cement relieving platform above the constructed columns to support each tank foundation ring. He also determined that utilizing soil-cement spoils in constructing relieving platforms also eliminated the off-site disposal potential of spoils contaminated with jet fuel. Post-treated soil-cement columns and relieve platforms achieved a minimum unconfined compressive strength of 200 psi.

Aerochrome Industries - Soil-Bentonite Slurry Cutoff Wall - San Antonio, TX
Mr. Naguib was the Project Manager for the design and construction of a 9,820 SF, 3 ft wide, 20 ft deep soil-bentonite slurry cutoff wall around a chromium-contaminated site, and also managed the design and construction of a down gradient groundwater interceptor trench to recover and treat contaminated groundwater. The cutoff wall and interceptor trench were capped with an impermeable soil-cement-bentonite mixture.

Balfour Beatty North Texas Turnpike Authority's VERT Wall - Irving, TX
Mr. Naguib was the Project Manager for the design and construction of a series of VERT retaining walls for a depressed roadway, replacing originally designed drill shaft retaining walls (auger cast piles with tie-backs). This included designing and installing a total 61,343 fascial SF of VERT retaining walls utilizing in-situ shallow soil mixing. Walls ranged in exposed height from 5 to 26 feet and were installed utilizing a 42-inch-diameter auger mounted on a Watson 2500 drill rig.

PREVIOUS EXPERIENCE

WRScompass (2001 - 2008)
Southern Regional Manager / Vice President - Geotechnical Group
Mr. Naguib's responsibilities included the management of Compass-Williams' Texas Office and the firm's Geotechnical Construction Group. His responsibilities included business development, coordination and supervision of projects, review and development of cost estimates, scheduling, cost tracking and control, and subcontracting.

Geo-Con (1990 - 2001)
Vice President - Central Region
Mr. Naguib served as Geo-Con, Inc.'s Vice President of Operations for the Central Region. He was also a member of Geo-Con, Inc.'s Executive Management Committee. Primary committee responsibilities included quarterly resource monitoring and assessments as well as corporate strategic planning.

EDUCATION

M.S., Construction Management Washington University in St. Louis
B.S., Civil Engineering - U.S. International University

TRAINING AND CERTIFICATIONS

OSHA 40-Hour HAZWOPER Training
OSHA 8-Hour HAZWOPER Refresher Training
OSHA 8-Hour Supervisory Course
LPS - Loss Prevention System Training

PUBLICATIONS

On-Site Mixing of Dry and Slurred Reagents in Soil and Sludge using Shallow Soil Mixing, Air & Waste Management Association's Annual meeting, June 1992
Design and Construction of Deep Soil Mix Retaining Wall for the Lake Parkway Freeway Extension, Geo-Congress 1998, Boston, MA, October 1998
Ground Improvement for Large Above-Ground Petroleum Storage Tanks Using Deep Mixing, Geo-Denver 2000, Denver, CO, August 2000

Erik R. Gehringer

ENTACT

REMEDIAL ACTION PROJECT MANAGER
REMEDIAL DESIGN: CONSTRUCTABILITY REVIEW
2002 - Present

Mr. Gehringer is a Civil/Environmental Engineer with more than 16 years of experience in the environmental and construction industries. He has been a key member of the management team on large environmental/civil works projects in several states varying in scope and complexity. His broad construction experience includes in-situ and ex-situ solidification/stabilization, soil treatment, large-scale excavation and material handling, cap and containment, CAMU construction, demolition, storm water management, sediment/marsh/wetlands remediation and restoration, sheet pile, slurry wall, and PRB installations, and levee, canal, and water control structures. As a Project Manager at ENTACT, Mr. Gehringer is responsible for all aspects of construction management including project engineering, scheduling, subcontractor coordination, contract administration, health and safety, procurement, estimating, field crew oversight/supervision, equipment operation, and customer communication.

ENTACT PROJECT EXPERIENCE

Former Phosphate Sites Remediation - Southeast
Mr. Gehringer serves as a Project Manager for various phosphate site removal actions located along the Ashley River Corridor in Charleston, South Carolina, as well as other locations in the southeast. Highlighted projects he is responsible for/has been responsible for include:

> **Former Phosphate Mill Site Non-Time Critical Removal Action:** ENTACT is performing a non-time critical removal action of lead and arsenic impacted soils and sediment at this former fertilizer manufacturing plant located along the Ashley River. Scope of work includes excavation of 44,915 cubic yards and stabilization of 6,671 tons of impacted soils; excavation of 7,114 cubic yards and solidification of 777 tons of impacted sediment; transportation and disposal of 88,451 tons; and restoration of affected uplands, wetlands, marsh, and floodplain areas.
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> **Former Agri-Chem Site Non-Time Critical Removal Action:** ENTACT performed a non-time critical removal action of lead and arsenic impacted soils and sediment in a salt marsh at this former fertilizer production site bounded by the Ashley and Cooper Rivers. Scope of work included installation of a low permeability exposure barrier (geotextile and backfill) over impacted surface soils; excavation of 73,500 cubic yards of slag and magenta-stained soils in the vadose and saturated zones from 1-13 foot depths; excavation and solidification of 3,000 cubic yards of impacted marsh and drainage ditch sediment; stabilization of 21,000 cubic yards of impacted soils; transportation and off-site disposal of 130,100 tons; amendment of 27,000 cubic yards of backfill material for groundwater treatment; and site restoration including wetlands plantings.

Former Chemical Works Fertilizer Manufacturing Site Removal Action: ENTACT performed a non-time critical removal action to address lead and arsenic impacts at this former chemical works fertilizer manufacturing site. Scope of work included excavation of 21,400 cubic yards, on-site stabilization of approximately 6,000 cubic yards, and off-site disposal of 36,000 tons of impacted soils covering an 8-acre area ranging in depth from 0.5 to 2 feet bgs; installation of a demarcation barrier prior to backfilling if impacts exceed 2 feet; and site restoration including common fill and topsoil placement, followed by revegetation with tree species and plant sizes required for habitat restoration in the upland, flood plain, and other selected areas.

Former Phosphate Site Non-Time Critical Removal Action: ENTACT completed a Non-Time Critical Removal Action at this former fertilizer production site to address lead and arsenic impacts in a marsh and uplands area. Scope of work included the excavation, stabilization, and offsite disposal of approximately 70,000 tons of impacted material, the placement of amended backfill material within the saturated zone to neutralize pH of existing groundwater, and the installation of a low permeability exposure barrier on surface soil. Other site activities included the excavation, solidification, and offsite disposal of sediments within a tidal marsh which required the construction of engineered access roads and the use of specialty excavation/hauling equipment. Restoration activities included importation and placement of sand backfill material and the installation of extensive wetlands plantings including native marsh grasses and various vegetative cover materials.

Industrial Complex Remediation - Henderson, NV
Mr. Gehringer was the Project Manager overseeing this multi-million dollar remediation project at a 2,000 acre site at an industrial complex in Henderson, Nevada. Major scope items included the systematic blending, drying, and solidification of 3.8M cubic yards of waste soils, sediment and sludges; phased construction of an on-site 53-acre CAMU; concurrent placement of the amended on-site waste materials within the CAMU; installation of a RCRA Subtitle C geosynthetic/soil cover system over the CAMU; and installation of all associated storm water management features. In addition, ENTACT designed and installed a deep steel sheet pile retaining system (<50 ft bgs) to afford access for an extremely dangerous excavation of pyrophoric wastes, blended VOC's and PCB's. This particular scope was completed in Level B conditions over a 7-month period.

Due to the excessively high moisture contents of the materials to be excavated from the 16 process ponds (<20% solids), 55 dry ponds, slit trench waste (VOC's, PCB's, metals, assorted debris), and other site excavations, ENTACT conducted months of treatability evaluations to reduce the moisture levels to a target of 80% solids. This process involved extensive geotechnical evaluations, mixing, free-draining, dewatering, and reagent evaluations of dozens of source materials. In the end, ENTACT developed a mixing regimen incorporating all of these parameters, resulting in millions of dollars of reduced costs.

Manganese Tailings Removal and Transport - Henderson, NV
Mr. Gehringer was the Project Manager overseeing the removal of 213,000 cubic yards of historic manganese tailings stockpiled within the Tronox facility at this chemical complex in Henderson, Nevada. Additional scope included implementing a Traffic Control Plan, transporting tailings to the off-site designated landfill, and performing final grading upon completion of the work.

Hall II Exposure Barrier Construction Project - Charleston, SC
Mr. Gehringer was the Project Manager for an additional phase of work at a large redevelopment in Charleston, South Carolina. Scope of work included removal of debris and vegetation and grading in preparation for exposure barrier construction; installation of a plastic demarcation barrier; placement and compaction of select fill and topsoil; and site restoration including hydroseeding with specified seed, fertilizer and mulch.

Active Refinery Stormwater Pond Remediation - Paulsboro, NJ
Mr. Gehringer was the Project Manager overseeing this ISS project that was executed utilizing the Lang Tool Mixer and an excavator with an air bucket with ENTACT specifically designing the reagent program (bench scale testing/mix design) for this application. The project was designed to address low strength sludge (TPH, SVOCs, RCRA Metals) and impacted sediments to a depth of 18 feet bgs. The ponds were historically used for dredge spoil storage and as a spent catalyst repository. An added challenge to the design program was modifying the design to address higher solid content and metals bearing catalyst waste. ENTACT installed a series of vacuum well points to maintain optimal moisture conditions for the selected slurry application. In excess of 75,000 cubic yards of catalyst, sediments and sludges were remediated in-situ with the Lang Tool Mixer, increasing the bearing capacity of the materials (50 psi UCS), and reducing the permeability (less than $1x10^{-6}$ cm/sec) to design standards. Achieving the geotechnical criteria for the project included the use of Portland cement hence requiring significant efforts to balance the pH in consideration of the projects' SPLP targets for chromium and arsenic. ENTACT utilized a two part reagent application to allow the conversation of chromium from hexavalent to trivalent prior to pozzolanic stabilization. ENTACT reached groundwater standards for Cr and As (.070 and .003 ug/ml, respectively) as designed. Upon completion of the ISS work, ENTACT imported, graded, and placed 73,000 cubic yards of clean fill material for the cap; installed access roads and a stone cover across the site; and completed site restoration activities.

Whitehouse Waste Oil Pits Superfund Site - Jacksonville, FL
Mr. Gehringer was the Project Manager for the multi-faceted remediation of this NPL site situated within the challenging environment of a Cypress Swamp. The swamp was influenced by Jacksonville's Cedar River, a tidal tributary of the Atlantic Ocean. Initial remedial activities required the relocation of a half-mile of the primary swamp channel to divert existing flow away from the former waste oil pits. The stream diversion was created by way of excavation, gabion baskets, and a concrete weir system construction. ENTACT excavated over 10,000 cubic yards of impacted sediments from within the cypress swamp while preserving the majority of native cypress trees. Sediment removal was accomplished using multiple long reach excavators staged on swamp mats that relayed material back to a staging area in a "hop-scotch" approach. The relaying of excavated materials in this manner provided an efficient means of conventional removal of shallow sediments, while the repeated handling provided additional gravity draining prior to solidification. All disturbed swamp areas were re-graded with native soils and re-populated with native wetland seed mixes, woody plant materials and shrubs.

The primary phase of the project included in-situ stabilization of 45,000 cubic yards of acidic hydrocarbon sludges/sediments using a Lang Tool Mixer to deliver an average unconfined compressive strength of 100 psi, a maximum permeability of 1×10^{-6} cm/sec, and significant SPLP leachability reduction (VOC's, SVOC's, PCB's, and

metals) in the treated product as measured for the highest concentration of the most toxic components including Antimony, Cadmium, Lead, Bis(2-ethylhexyl)phthalate, and Aroclor. A TCLP extract concentration for Lead below the hazardous level of 5 mg/l was also achieved. ENTACT employed a slurried reagent application (Portland cement & water) in order to provide the best end product and to preclude the generation of VOC/SVOC emissions and airborne particulates, routinely observed in pneumatic applications. No airborne emission exceedences (perimeter or otherwise) of VOC's/SVOC's/PCB's/Particulates were observed throughout the entire two and a half month process. In fact, the measurable VOC concentrations were so low that a PPE downgrade from Level C to Level D was made after a couple of weeks of continuous, integrated air monitoring.

The final portion of the project included the installation a 3,100 linear foot perimeter slurry wall up to 80-feet in depth; construction of an 11.5-acre RCRA compliant capping system over the entire site; installation of an extensive underdrain network which serves as a stormwater collection system; and installation of a gas collection system.

Macalloy NPL Site - Charleston, SC
Mr. Gehringer was the Project Manager for a large-scale remediation effort at this former ferrochromium alloy production plant. Site activities included the excavation, transportation, and disposal of radiological debris-contaminated soil; ex-situ stabilization and chemical reduction via pugmill and pile mixing of 205,000 cubic yards of chromium VI impacted soils (covering over 50 acres); the removal and in-situ stabilization of 2,200 cubic yards of surficial sediments within a tidal marsh using swamp buggies and pontoon excavators. The marsh sediments were stabilized and treated in-situ in an on-site containment/dewatering cell constructed adjacent to the tidal marsh prior to being utilized as on-site fill and capping material. Upon completion of the marsh removal activities, a layer of geotextile and an 18-inch layer of sand were installed over the excavation area prior to an extensive re-vegetation effort to restore the impacted marsh. Additionally, 207 temporary injection wells and 20 temporary monitoring wells were installed as part of the groundwater remediation phase of the work which has effectively reduced the levels of chromium VI impacted groundwater at the site. Upon completion of remediation activities, an extensive stormwater collection and management system was installed which consisted of 5,600 lineal feet of 12" to 60" reinforced concrete conveyance pipe, 18 precast concrete structures, and two 42" water control valves. Over 5,000 lineal feet of diversion and collection canals were constructed which ultimately drained into a newly constructed 5-acre stormwater detention pond. Other activities performed on this 130-acre site included extensive clearing and grubbing, water management, construction of multiple riprap structures including permanent check dams and spillway overflow structures, and extensive site-wide grading activities. Over 100,000 cubic yards of site fill was relocated, over 46,000 tons of crushed limestone was placed, and over 125,000 cubic yards of clean fill material was imported, placed, and compacted to the required density to achieve final site grades prior to completing site wide restoration activities. The area impacted by the dredging traffic was restored using a combination of natural regeneration, seeding and plugs of the marsh grass, and spartina alterniflora.

ENTACT developed several candidate reagent blends as part of a Bench Scale Study in our in-house treatability lab to reduce both the concentrations and leachability of hexavalent chromium in the affected soils. This process involved a two-step approach, the first being a valence adjustment by way of sulfate additions (proprietary patent pending) to convert the less stable hexavalent chromium to the more stable trivalent chromium. Once converted, the second step involved pH buffering and stabilization via pozzolanic reagents (Portland cement and lime) to limit the amount of leachability.

Additional work at this site included demolition, size reduction, and off-site disposal of a former ferro-chrome manufacturing facility including the old foundry building (approximately 600' x 150' x 40' high), warehouse, laboratory, offices, and miscellaneous structures including the on-site wastewater treatment plant, multiple rail and truck scales. This work included the recycling of over a thousand tons of steel, the proper disposal of dozens of capacitors and transformers, asbestos abatement, and the recycling and/or disposal of thousands of gallons of various liquids including used oil, acids, and caustics. Moreover, ENTACT implemented over 250,000 cubic yards of on site earthwork to construct the site cover system, drainage channels, and retention basins and the installation of thousands of feet of reinforced concrete pipe and associated manholes and outfalls.

Lastly, ENTACT performed PRB construction to address isolated areas of impacted groundwater. Scope of work included in-situ construction via trenching of 4 supplemental permeable reactive barriers, totaling 350 feet, 25 feet upgradient of 4 designated monitoring wells. Each PRB was approximately 4 feet wide and 18 feet deep. Chemical reductants included ferrous sulfate, sodium hydrosulfite, and crushed granite.

Former Manufactured Gas Plant - Lake Charles, LA
Mr. Gehringer was Project Manager for remediation of this former manufactured gas plant located adjacent to the Calcasieu River. The Project objective was to remove significant amounts of point source wastes that were contributing to upper groundwater aquifer contamination. Scope of work included dewatering, excavation,

characterization, and off-site disposal of over 5,000 tons of mixed wastes; treatment of impacted ground-water intercepted during remediation activities; and backfilling and restoring affected areas.

Jernigan Trucking Dump Site Removal Action - Seffner, FL
Mr. Gehringer was the Project Manager for the remediation of this 179-acre site formerly used as a dump site for construction and demolition debris, miscellaneous trash, and lead-acid battery casings. Project activities included excavation of a road comprised of battery chips and casings, coal slag, blast furnace slag, and lead and arsenic soils above Removal Action Levels (RAL's); removal of 2 stockpiles of battery chips and casings; removal of a slag pile; grading for drainage removal areas where RAL's were achieved; installing a 2-foot soil cover over excavated areas where RAL's were not achieved; and revegetation all disturbed areas. All excavated material was transported to a stockpile management area for sampling and on-site stabilization, if necessary, prior to off-site disposal.

Residential and Marsh Sediment Remediation and Restoration - Beaufort, SC
Mr. Gehringer was the Project Manager for the sediment remediation portion of this project. ENTACT was engaged to complete removal of lead and arsenic impacted soils from 39 residential lots, commercial areas, and along the right-of-ways of a road maintained by the South Carolina DOT. Scope of work included excavation and off-site disposal of over 47,000 tons of impacted soils; removal of 17,000 tons of near-shore sediment from within a tidal zone of the adjacent river; on-site chemical stabilization of over 6,000 tons of soils/sediment; backfilling of disturbed areas; and revegetation of the tidal marsh with native grass.

Durban Creek - Fountain Inn Cleanup - Charleston, SC
Mr. Gehringer was the Project Manager for this project that involved the solidification, removal, transportation and off-site disposal of wastewater treatment plant sludge contained in two digesters at this facility.

Magnolia Demolition Project - Charleston, SC
Mr. Gehringer was the Project Manager for this demolition project. Scope of work included demolition of 6 buildings and various concrete structures including former warehouses, auto/diesel garages, and office buildings. This project also included the removal and recycling of more than 1,000 feet of railroad track and the proper disposal of the cross ties. Over 10,000 tons of concrete foundations, footings, slabs, and other structures were size reduced for future use.

Former Oil Refinery - Casper, WY
Mr. Gehringer was the Project Manager for this former refinery environmental remediation project. The scope of work included the decommissioning of existing sludge ponds with the excavation, stabilization, and hauling of PAH impacted soils and sediments. Additional site activities included the removal of abandoned 12' diameter transite piping located beneath four active gas lines.

Active Battery Manufacturing Facility NTC Removal Action - Winston-Salem, NC
Mr. Gehringer was Project Manager at this site where work was being conducted in response to an USEPA Emergency Removal Order. The scope of work included the excavation and stabilization of lead-impacted soils and sediments, installation/upgrading stormwater piping, construction of new sedimentation basin, and removal of three (3) existing sediment basins from service. Mr. Gehringer also the design engineer in incorporating actual field conditions into the final design before construction activities were initiated.

PREVIOUS EMPLOYMENT

IT Corporation - Miami Lakes, FL (1997 - 2002)
Mr. Gehringer worked on-site in various roles on many projects in the Everglades Restoration and Watershed Program. Highlighted projects are included below.

Stormwater Treatment Area 3/4 Supply Canal Project - South Florida Water Management District
Mr. Gehringer was the Project Manager for a large civil construction project located in South Florida. The project consisted of clearing approximately 600 acres of existing vegetation, the mass excavation of over 3 million cubic yards of material from over 30 miles of canals, and the construction or improvement of over 20 miles of levees. Mr. Gehringer was responsible for all aspects of the job including client relations, overall site coordination, resource allocation, scheduling, progress/production tracking, human resource issues and all the financial responsibilities including estimating, preparing monthly client invoices, cost tracking/reporting, and margin analysis.

Kissimmee River Florida Project, Reach 1 - Lorida, FL
Mr. Gehringer was the Project Controls Engineer/Health & Safety Officer for this large civil works project that involved earthmoving 12 million cubic yards of fill material, dredging over 190,000 cubic yards of original river channel, demolition of existing water control structures, levee/haul road degradation, and the installation of miscellaneous items including staff gauges, project signs, and safety barriers. Mr. Gehringer was responsible for

developing/updating project controls systems to track/report production vs. daily cost; preparing monthly invoices for the U.S. Army Corps of Engineers; preparing subcontractor bid packages, evaluated quotes, and awarding subcontracts; participating in meetings with the USACE and South Florida Water Management District (SFWMD); developing/updating the integrated project schedule; assisting with engineering duties including establishing grade control, layout, and other surveying; and handling all financial aspects of the job including communications with the Project Manager and the home office of the current costs, revenue, margin, and cash flow.

Harry Pepper & Associates, Stormwater Treatment Area 1 West - Loxahatchee, FL
Mr. Gehringer was the Project Engineer/Superintendent for this civil works project involved the construction of levees, canals, and water control structures to provide a Stormwater Treatment Area (STA) in the Florida Everglades. Scope consisted of the excavation of over 23 miles of canals and associated levees; construction of 24 water control structures; disking and preparation of approximately 15,000 acres of sugarcane fields; and demolition of a bridge, storage buildings, and an abandoned pump station which required soil testing/remediation. Mr. Gehringer provided oversight to multiple survey crews, including verification/quality control of work performed; updated the project schedule; prepared monthly invoices; prepared, reviewed, and coordinated vendor submittals; supervised field crews including subcontractors and HPA personnel; and prepared as-built drawings for water control structures, levees, canals, and other structures

Maxey Flats Waste Disposal Site - Morehead, KT
Mr. Gehringer was the Project Controls Engineer/Field Engineer for this abandoned low-level radioactive waste site. Scope of work included pumping over 850,000 gallons of leachate from the ground, mixing it with cement to form grout, and disposing of it into a 300' x 100' x 10' concrete bunker. During construction, over 5,000 cubic yards of concrete were poured, thousands of feet of piping were assembled, drainage ditches were constructed, demolition of existing structures was completed, and various other tasks. Mr. Gehringer was responsible for scheduling activities with the Prime contractor and its subcontractors; prepared monthly progress/cost reports; analyzing cost vs. revenue and margin; participating in meetings and contractor/client negotiations including change orders/task plans; developing estimates and schedules; approving time sheets, vendor invoices, and subcontracts; and performing field engineering duties including scheduling daily activities, surveying, and utilizing the 2-week look ahead and overall schedule to requisition material and equipment.

Precision Masonry - Franklinville, NJ (1992 - 1997)
Concrete Finisher/Bricklayer/Laborer
Mr. Gehringer worked on various projects that encompassed many areas of the masonry trade including concrete, brick, block, and stone. Projects ranged from small residential jobs to large commercial projects. Mr. Gehringer was primarily responsible for supervising work crews, procuring materials, laying brick and block, tying rebar, constructing formwork, placing/finishing concrete; assisting in proposal development and working closely with building inspectors and clients to maintain the product required by the plans and specifications.

EDUCATION

B.S., Civil/Environmental Engineering - Construction Management Emphasis. Rutgers College of Engineering, Rutgers University, New Brunswick, New Jersey

TRAINING AND CERTIFICATIONS

OSHA 40-Hour HAZWOPER Training
OSHA 8-Hour Annual Refresher
OSHA 8-Hour HAZWOPER Supervisor Training
OSHA 30-Hour Construction Safety Training
Competent Person - Excavation
OSHA Hearing Conservation Training Program - 29 CFR 1910.95 (k)
OSHA Hazard Communication - 29 CFR 1910.1200 (h)
Confined Space Entry Supervisor/Attendant/Entrant
LPS Behavior Based Safety Training
Adult CPR/AED/First Aid Certified
Engineer-in-Training (EIT): New Jersey (transferable to most states)
Certified S.C.U.B.A Diver (PADI)
IT Site Safety Officer Training
Defensive Driving
Trained on the proper inspection of Excavators, Dozers, Water Trucks, Haul Trucks and Compactors to ensure proper maintenance and safe operation - 2926.600 and 1926.602, Subpart 0
Primavera^3 Project Management Training Program, Philadelphia, Pennsylvania

Tom Zodrow

ENTACT

REMEDIAL ACTION: SITE SUPERINTENDENT

1992 - Present

Mr. Zodrow possesses over 18 years of experience in the environmental and construction industries. As a Project Manager at ENTACT, Mr. Zodrow is responsible for project planning, direction and oversight of field activities, field crew leadership, management of subcontractors and vendors, customer communication, forecasting, scheduling, project reporting, health and safety, project compliance with regulatory and technical requirements, and the timely execution of ENTACT projects.

Specifically, Mr. Zodrow has been a Site Superintendent on challenging material handling projects that incorporate dewatering and solidification/stabilization of soils/sediments and wastes. Mr. Zodrow has also been a key part of ENTACT's success in implementing our deep in-situ stabilization (ISS) technologies in the field.

ENTACT EXPERIENCE SUMMARY

Active Refinery Proposed Tank Footprint Subsurface Ground Improvement Project - MS
Mr. Zodrow is the Field Project Manager for subsurface soil treatment at this active refinery that is currently undergoing expansion. ENTACT is implementing subsurface ground improvement measures at 16 proposed tank footprints to minimize the potential for future tank foundations settlement. Scope of work includes installing a series of soil-cement columns underneath the planned footprint of each tank foundation. ENTACT is employing (2) In-Situ Vertical Auger Mixing Rigs complete with their respective Grout Batch Plants that will work concurrently in order to accomplish the specified work within the allotted durations. ENTACT designed and implemented a series of treatability studies at our in-house laboratory to determine the optimum reagent and delivery program required to meet project objectives and performance criteria.

Active Refinery SWMU Closure - Martinez, CA
Mr. Zodrow was the Field Project Manager responsible for overseeing ISS activities at this active refinery. Project scope activities included closure of a SWMU via in-situ solidification/stabilization. Contaminants of Concern (COC) included heavy metals, PAH, volatile organic compounds, and petroleum hydrocarbons. Performance criteria included meeting an unconfined compressive strength of 10 psi, a permeability of less than $2.1x10^{-6}$ cm/sec, and an admixture pH of less than 11.5. Field activities included ISS of approximately 67,500 cubic yards of impacted material in the former tar pits utilizing a large diameter auger (ENTACT's Delmag RH-32) and a GeoDrill, and then capping the closed in place waste.

Confidential Superfund Site - Liberty County, TX
Mr. Zodrow was the Field Project Manager for this Superfund site remediation. Scope of work included mixed-grid hazardous soil excavation and segregation of clean overburden; in-situ chemical oxidation of impacted soils in the vadose zone via an admixture of hydrated sodium persulfate and Portland cement delivered and mixed by a custom designed DELMAG drilling unit equipped with a K0065lly Bar type drill stem and 5 foot diameter auger; placement and re-grading of stripped topsoil and overbuden to the treated area; and restoration of disturbed areas with natural grass vegetation. The chemical oxidation process employed an innovative technology whereby the initial oxidant of sodium persulfate was enhanced and accelerated by the introduction of a pH modifier that created a secondary oxidation reaction through the generation of "sulfate radicals" within the treatment zone. In addition, to ensure the integrity of applied in-situ treatment, and to preserve the maximum "reactive capacity" of the chemical oxidation reagents being injected, ENTACT used its custom designed equipment configuration made entirely of stainless steel. All contact surface areas within the batching plant, delivery conveyances, and including the drilling auger itself are made of the non-reactive steel alloy.

Active Terminal Remediation - Bayonne, NJ
Mr. Zodrow was the Project Manager for the stabilization/solidification element of this project. Prior to project start-up, ENTACT completed an exhaustive bench scale treatability to select reagents capable of stabilizing the sediments and producing the required strength and permeability for an interior and perimeter mix requirement. A full scale pilot test was then performed using the mix designs identified in the bench scale treatability. Sediment cells of 100 cubic yards were established to perform trial mixing of the successful bench-scale mix designs. Some variations on addition rates and methods (dry versus slurry) were tested to determine the flexibility of the mix designs.

ENTACT installed sheetpile to isolate the canal from the remainder of Platty Kill and installed dewatering pumps to maintain water in-leakage within the canal. Approximately 12,000 cubic yards of onsite impacted soils were selected and relocated to the canal for inclusion in the interior mix. Onsite soils were mixed using a hydraulic excavator, followed by slurried Portland cement using a Lang Tool for mixing as deep as 18-20ft. As the interior cells progressed, the perimeter cells followed using a hydraulic excavator to add the low-perm clay material with dry bentonite, followed by slurried bentonite using a Lang Tool. The completed stabilized sediment was capped with additional onsite soils, and a perimeter interceptor trench with vertical sumps was installed. The cell was covered with a GCL-based geomembrane cover system and seeded.

Active Refinery Stormwater Ponds Closure Project - Paulsboro, NJ
Mr. Zodrow was the Site Superintendent for this stormwater ponds remediation. ENTACT implemented this ISS project that was executed utilizing the Lang Tool Mixer with ENTACT specifically designing the reagent program (bench scale testing/mix design) for this application. The project was designed to address low strength sludge (TPH, SVOCs, RCRA Metals) and impacted sediments to a depth of 12 feet bgs. The ponds were historically used for dredge spoil storage and as a spent catalyst repository. An added challenge to the design program was modifying the design to address higher solid content and metals bearing catalyst waste. ENTACT installed a series of vacuum well points to maintain optimal moisture conditions for the selected slurry application. In excess of 70,000 cubic yards of catalyst, sediments and sludges were remediated in-situ with the Lang Tool Mixer, increasing the bearing capacity of the materials (>20psi UCS), and reducing the permeability ($<1x10^{-6}$ cm/sec) to design standards. Achieving the geotechnical criteria for the project included the use of Portland cement hence requiring significant efforts to balance the pH in consideration of the projects' SPLP targets for chromium and arsenic. ENTACT utilized a two part reagent application to allow the conversation of chromium from hexavalent to trivalent prior to pozzolanic stabilization. ENTACT reached groundwater standards for Cr and As (.070 and .003 ug/ml, respectively) as designed. The project was completed by grading and capping the former ponds with a stone cover system.

Former Oil Storage and Terminal Facility - MD
Mr. Zodrow was the Project Manager for the remediation of this former oil storage and terminal facility. Historical operations resulted in hydrocarbon impacts to the underlying soils and water table. ENTACT conducted in-situ solidification/stabilization of 12,500 cubic yards of hydrocarbon impacted soil using a Lang Mixer in order to increase bearing capacity (to an average of 35 psi), decrease permeability (to less than 1 x 10^{-6} cm/sec), and reduce leachability of Diesel Range Organics /Gasoline Range Organics (DRO/GRO) which was confirmed by way of SPLP testing of VOC's and SVOC's ton on-detect levels in the treated end product. ENTACT conducted multiple rounds of treatability studies and optimized a slurry mix design for the project prior to mobilization. Additional site work included pipe removal, general site grading, well abandonment, fence relocation, and dewatering.

Former Terminal - GA
Mr. Zodrow was the Project Manager for this terminal remediation. Scope of work included excavation, solidification and off-site disposal of 25,000 tons of wet petroleum hydrocarbon sediment from tidal marshes impacted from historic terminal operations. ENTACT diverted the existing tidal drainage channel for the Island and initiated a comprehensive water management program by installing a series of dams with sleus gates, gravity drained culverts and large diameter pump-around systems. All site activities included continuous water management practices and the use of crane mats to create a stable platform and even weight distribution for long-stick excavators to remove the submerged oily wastes and solidify them to pass liquid paint filter requirements for the off-site disposal facility. Restoration activities included backfilling with select wetland soils and revegitation of disturbed area with over 5,000 native wetland plants (spartina alterniflora).

Emmett Reed Park Removal Action - Jacksonville, FL
Mr. Zodrow was the Project Manager for this removal action at a city park. Scope of work included the excavation of lead-impacted incinerator ash and glass particle contaminated soils, stockpiling and management of waste materials, TCLP laboratory analysis of staged materials, on-site stabilization of RCRA waste constituents (where necessary), and the off-site transportation and disposal of approximately 7,000 tons of lead impacted soils. Excavation sites were protected by placement of a geo-grid barrier fence prior to backfilling with clean soil and site restoration planting. The cleaned up park was developed into a tennis facility with Federal Parks and Recreation Grant funds. ENTACT completed the installation of several civil construction features including concrete mats, retaining walls, side walks, and new utilities (e.g. water, sewer, storm water).

Whitehouse Waste Oil Pits Superfund Site - Jacksonville, FL
Mr. Zodrow was the Site Superintendent for the remediation of this former waste oil and sludge disposal facility. Scope of work included in-situ stabilization of 45,000 cubic yards of acidic hydrocarbon sludges/sediments within a tidally influenced cypress swamp. The project was executed using a Lang Tool Mixer delivering an average unconfined compressive strength of 100 psi, a maximum permeability of 1×10^{-7} cm/sec, and significant SPLP leachability reduction (VOCs, SVOCs, PCBs, and RCRA Metals) in the treated project as measured for the highest concentration of the most toxic components of Antimony, Cadmium, Lead, Bis(2-ethylhexyl)phthalate, and Aroclor. A TCLP extract concentration for Lead below the hazardous level of 5 mg/L was also achieved. ENTACT employed a slurried reagent application (Portland cement and water) in order to provide the best end product and to preclude the generation of VOC/SVOC emissions and airborne particulates, routinely observed in pneumatic applications. No airborne emission exceedences (perimeter or otherwise) of VOC/SVOC, PCB or particulates were observed throughout the entire two and a half month stabilization process. Additional site activities included relocation of half-mile of an existing stream away from the former waste pits; excavation of 10,000 cubic yards of impacted sediments from within a cypress swamp; installation a 3,100 linear foot perimeter slurry wall up to 80-feet in depth; construction of an 11.5-acre RCRA compliant capping system over the entire site; installation of an extensive underdrain network which serves as a stormwater collection system (included approximately 9,000 lineal feet of 4" to 30" HDPE and reinforced concrete pipe); installation of a gas collection system, and wetlands restoration.

Macalloy NPL Site - Charleston, SC
Mr. Zodrow was the Project Manager for this large-scale remediation project. Site activities included the excavation, transportation, and disposal of radiological debris-contaminated soil; ex-situ stabilization and chemical reduction via pugmill and pile mixing of 205,000 cubic yards of chromium VI impacted soils (covering over 50 acres); the removal and in-situ stabilization of 2,200 cubic yards of surficial sediments within a tidal marsh using swamp buggies and pontoon excavators. The marsh sediments were stabilized and treated in-situ in an on-site containment/dewatering cell constructed adjacent to the tidal marsh prior to being utilized as on-site fill and capping material. Upon completion of the marsh removal activities, a layer of geotextile and an 18-inch layer of sand were installed over the excavation area prior to an extensive re-vegetation effort to restore the impacted marsh. Additionally, 207 temporary injection wells and 20 temporary monitoring wells were installed as part of the groundwater remediation phase of the work which has effectively reduced the levels of chromium VI impacted groundwater at the site. Upon completion of remediation activities, an extensive stormwater collection and management system was installed which consisted of 5,600 lineal feet of 12" to 60" reinforced concrete conveyance pipe, 18 precast concrete structures, and two 42" water control valves. Over 5,000 lineal feet of diversion and collection canals were constructed which ultimately drained into a newly constructed 5-acre stormwater detention pond. Other activities performed on this 130-acre site included extensive clearing and grubbing, water management, construction of multiple riprap structures including permanent check dams and spillway overflow structures, and extensive site-wide grading activities. Over 100,000 cubic yards of site fill was relocated, over 46,000 tons of crushed limestone was placed, and over 125,000 cubic yards of clean fill material was imported, placed, and compacted to the required density to achieve final site grades prior to completing site wide restoration activities. The area impacted by the dredging traffic was restored using a combination of natural regeneration, seeding and plugs of the marsh grass, and spartina alterniflora.

Schuylkill Metals NPL Site - Plant City, FL
Mr. Zodrow was the Field Project Manager responsible for the development of an on-site stabilization/solidification method for 250,000 cubic yards of battery casings, debris and soil from a former battery breaking operation. EPA remedial performance criteria for treated materials included hydraulic conductivity specifications of $<1.0 \times 10^{-6}$ cm/sec, unconfined compressive strength criteria of >50 psi, <5.0 mg/l TCLP lead and <.015 mg/l SPLP lead. ENTACT designed and constructed a patented on-site stabilization and solidification unit and chemical additive blend which reduced the total additive mix design from 42% to less than 20% by weight. Mr. Zodrow directed field excavation activities, achieved treatment production and quality objectives, maintained sample QA/QC in an on-site laboratory, organized material processing activities, and coordinated construction of an on-site monolith with a 5 acre cover system.

Active Paper Mill Remediation - Roaring River, NC
Mr. Zodrow was the Project Manager for this active paper mill remediation. Scope of work included ex-situ treatment using calcium oxide for 3,500 cubic yards of waste, followed by ex-situ treatment with augmented bioremediation for the remaining 6,500 cubic yards of waste. All excavated areas were backfilled and restored upon completion of remediation activities.

Browns Battery Superfund NPL Site - Shoemakersville, PA
Mr. Zodrow was the Site Superintendent for the remediation of this former battery breaking facility. Scope of work included design and implementation of a treatability study; excavation and on-site stabilization of approximately 43,000 cubic yards of lead-impacted material; dewatering a reach of the Schuylkill River and installation of a permanent riverbank stabilization measure; and site restoration including backfill, compaction, and grading.

Universal Foods - Dallas, TX
Mr. Zodrow was the Field Project Manager for the remediation of a former battery manufacturing operation and surrounding railroad areas. Project tasks included demolition of 120,000 square feet of concrete slab, excavation of 12,000 cubic yards of contaminated soils, debris and battery components, decontamination and dismantling of 750 feet of railroad track, on-site stabilization of 6,500 cubic yards of excavated material, and off-site transportation and disposal.

Jones Tire and Battery NPL Site - Birmingham, AL
Mr. Zodrow was the Project Manager for the remediation of a former battery breaking operation under a CERCLA 106 unilateral Administrative Order. Removal action tasks included excavation of 75,000 cubic yards of contaminated soils, debris and battery components, on-site stabilization of 57,000 cubic yards to levels below 5.0 TCLP Lead, facility decontamination and demolition, and construction of a 4.3 acre on-site multi-layer cap and liner system.

7th Street Lead Site - Des Moines, IA
Mr. Zodrow was the Project Manager for removal action tasks mandated under a CERCLA 106 Unilateral Administrative Order. The scope of work included excavation of contaminated materials affected by facility operations, on-site stabilization of excavated materials and off-site disposal. On-site remedial activities were completed during extreme rain and flood conditions. Mr. Zodrow directed the excavation of 12,000 cubic yards of contaminated soil, debris and battery chips from industrial and residential areas, stabilization of 7,000 cubic yards of material to levels below 5.0 mg/l TCLP lead and off-site transportation and disposal activities of all materials.

PREVIOUS EXPERIENCE

Southern Enviro Technology - SET (1991 -1999)
Project Manager

Southern Waste Management (1990 - 1991)
Waste Transportation Manager

TRAINING AND CERTIFICATIONS

OSHA 29 CFR 1910.120 (e) Supervisor Training
OSHA 29 CFR 1910.120 8-Hour Refresher (annual)
LPS Behavior Based Safety Training
Certified Confined Space Entry
OSHA Compliance Strategies: General Industrial 501 Course
RCRA Fundamentals
Advanced RCRA Topics
RCRA Land Disposal Restrictions

LIN LIU, PHD, P.E.

ENTACT

REMEDI AL DESIGN: ALL SCOPES – DESIGN SUPPORT
REMEDIAL ACTION: ON-SITE FIELD ENGINEER
2007 – Present

Ms. Liu is a Professional Engineer with more than 25 years of combined experience in the areas of civil/geotechnical engineering, remedial construction oversight, and geotechnical research, with the last 20 years devoted to hazardous and solid waste projects. She specializes in geotechnical engineering design and oversight and regularly serves as a Quality Assurance/Quality Control (QA/QC) Officer and Field Engineer during cap installation, soil stabilization, and slurry wall and leachate collection system construction. Ms. Liu's background includes performing QA/QC oversight, site investigations, data management, detailed design and analysis, cost estimates, and report and specification preparation. Her broad project experience has included the design and construction oversight for landfill, slurry wall, and leachate collection system projects, subsurface investigations, geotechnical laboratory testing, foundation design and analysis, and slope stability and seepage analyses. Additionally, Ms. Liu is a Treatability Testing Engineer for our in-house treatability laboratory in which she is responsible for overseeing the bench scale testing, evaluation of the results, and preparation of treatability test reports.

ENTACT EXPERIENCE SUMMARY

Asphalt Terminal ISS and Remediation Cover Construction Project – MD
Ms. Liu is the Field Engineer for the in-situ solidification/stabilization of approximately 20,000 cubic yards of LNAPL impacted native and fill soils to depths ranging from 4 to 10 feet in a 99,000 square foot area in the former tank basin. ISS is being accomplished utilizing a reagent program consisting of Portland cement and bentonite and bucket mixing to meet a permeability range of 1 x 10-6 cm/s to 1 x 10-7 cm/s and strength improvements. Additional scope includes grading, installation of a warning fabric, and construction of a 2-foot soil cover over an approximate 2-acre arsenic impacted area to serve as an institutional control to preclude future excavation in this area. ENTACT performed a treatability study at our in-house laboratory to develop specific mixtures that was the basis of the approved RAWP.

Active Refinery - MS
As part of a key supplier program, ENTACT provides engineering and remediation services to support both Corrective Action and Capital Expansion projects at this active refinery. Ms. Liu has served as both a Project Engineer and Field Engineer to support ENTACT teams. Highlighted projects include the following:

Tank Pads - Ms. Liu served as a Project Engineer for subsurface ground improvement measures at 16 proposed tank footprints to minimize the potential for future tank foundations settlement. Scope of work currently includes installing a series of soil-cement columns underneath the planned footprint of each tank foundation. ENTACT is employing (2) In-Situ Vertical Auger Mixing Rigs complete with their respective Grout Batch Plants that will work concurrently in order to accomplish the specified work within the allotted durations.

100-acre Lagoon Sediment Removal - Ms. Liu was the Project Engineer responsible for treatability and Design preparation for this 100-acre lagoon sediment removal project. ENTACT completed a Bench Scale Treatability Study to determine the best ISS methodology, most efficient reagent blends, and the specific dosages for the dewatering and ISS treatment of over 75,000 cubic yards of sediments. ENTACT developed the ISS specifications and Work Plans, the Lagoon Segmentation Plan, Water Management Plan, and the ISS process plans (PFDs, PIDs, Schematics, etc.). Execution activities included lagoon segmenting, segment dewatering, and ISS of sediments (to meet various metals leachability limits and a minimum UCS of 15 psi), followed by subsequent removal and placement of the treated sediments into an on-site consolidation cell. A sediment quantity of 75,000 cubic yards was removed from the 100-acre lagoon, while maintaining the lagoon in service at an operating capacity of 80% and not adversely impacting NPDES requirements at the outlet of the lagoon. Removal was followed by restoration of the banks to reduce eco-availability of the lagoon and lagoon sediments. Sediments were solidified using our own slurried-Portland cement batch plant and pumps, followed by hauling and placement in the consolidation area. All process dewatering was completed using both low-flow flocculation and filtration processes, and high-flow hydrocylonic cleaning and DE filter press operations. The placement of solidified sediments was used as part of the core-fill material for a future flood structure.

Sydney Tar Ponds - Novia Scotia, Canada
ENTACT is providing Solidification/Stabilization Technical Assistance to our Canadian Joint Venture Partner, Nordlys, for the Sydney Tar Ponds project in Nova Scotia. ENTACT performed the Solidification/Stabilization mix designs in its treatability lab, as well as provided assistance to Nordlys in proposal preparation, cost estimating and completion of required submittals. The Solidification/Stabilization field pilot program was completed in late 2009. Work will be completed in consecutive phases over the next 3 years, with Phase I completed in 2010. During the construction phase, ENTACT provides Solidification/Stabilization supervision personnel and quality control officers (total of 10 individuals) to oversee the work. Scope includes solidification/stabilization of approximately 570,000 cubic meters of impacted sediment, with treated sediment being required to achieve permeability less than 1 x 10-6 cm/sec, minimum unconfined compressive strength of 25 psi and achieve modified leachability limits specific to this project. Ms. Liu is a Field Engineer overseeing QC measures at this site.

Refinery SWMU Closures - Martinez, CA
Ms. Liu was the Field Engineer for a performance based in-situ stabilization/solidification, cap and closure project at this active oil refinery in California. The Contaminants of Concern (COC) included heavy metals, PAH, volatile organic compounds, and petroleum hydrocarbons. The Corrective Measure stabilization/solidification performance criteria included an unconfined compressive strength of 10 psi at 7 days curing time, a post-treatment permeability coefficient of less than 2.1x10-6 cm/sec, and an admixture pH of less than 11.5. Prior to field implementation, ENTACT completed the analysis of existing treatability data; production of a method and procedure for reagent formulation and dosage applications; and development of an in-situ treatment technique (equipment configuration) for a mixed grid of multiple treatment depths, varying waste soil bulk densities, and varying concentrations for treatment of each grid type with a slag cement slurry reagent. Other performance criteria included the control of fugitive emissions (particulate and gaseous), odor suppression and abatement, and an overall safety plan for working within an active refinery operation. Field activities included the in-situ stabilization/solidification of approximately 75,000 cubic yards of impacted material in the former tar pits utilizing a large diameter auger (ENTACT's Delmag RH-32) and a GeoDrill; the preparation of post-treatment sub-grade shapes, slopes and elevations; placement of select fill materials, the installation of woven geo-textiles and LLDPE liners; and final cap and cover construction. Permanent storm water drainage channels, tie-in to existing sub-surface sewer lines, construction of new man-holes, placement of new pre-cast drainage culverts, and asphalt paving and site restoration were also development features included in the Scope of Work.

Confidential NPL Site - Carlstadt, NJ
Ms. Liu was the Project Engineer for this NPL Site remediation. This Site once housed a former industrial waste handling, treatment and disposal facility. Our scope of work included installation of a 600 linear foot sheet pile wall to an average depth of 42 feet along Peach Island Creek; demolition of buildings and structures; construction of a groundwater recovery system (vertical wells, horizontal headers, leachate collection tank, and building); and partial installation of a site wide cap consisting of geosynthetic clay liner, 40 mil geomembrane, geocomposite drainage layer, 18 inches of common fill, 6 inches of vegetative cover soil. To address the hot spot area, ENTACT completed a Field Verification Program (FVP) of the In-situ Air Stripping and In-situ Stabilization (ISAS/ISS) using our Delmag RH-32 Deep Soil Mixing Drill Rig equipped with an 8-foot diameter auger and 40 foot long kelley bar. The system collected emissions using a custom 10-foot diameter shroud designed and fabricated by ENTACT operating under negative pressure for collection and treatment of particulates and VOC emissions.

FMC Facility Remediation - Middleport, NY
Ms. Liu was the Field Engineer for this facility and residential remediation project. Scope of work included remediation and restoration of 11 arsenic impacted residential lots; removal of brick and concrete debris; excavation and on-site disposal of 11,750 cubic yards of impacted soil; restoration of the disturbed area with an engineered surface cover system consisting of general fill, a demarcation barrier, stone, topsoil and seed; extension of a ditch; installation of a 1.4-acre engineered surface cover system consisting of 40 mil HDPE geomembrane, a non-woven geotextile, 12-inches of select fill, a demarcation barrier, 8 inches of general soil fill, and 4 inches of topsoil; and installation of a cover system over the on-site disposal area upon project completion.

PREVIOUS EXPERIENCE

AlliedSignal Goldcamp Disposal Area - Ironton, OH
Ms. Liu was a Project Engineer for a slurry wall construction project at AlliedSignal's Goldcamp Disposal Area in Ironton, Ohio. The slurry wall was approximately 2,000 feet long and averaged 80 to 85 feet deep. Ms. Liu monitored slurry wall installation; performed testing on slurry; supervised the backfill mixing

operation and placement; and communicated daily with AlliedSignal regarding construction status and testing results.

Ms. Liu also performed field oversight and technical support for the in-situ treatment of a contaminated area which included hazardous concentrations of metals and VOCs, via in-situ stabilization/solidification (ISS). ISS activities included using a slurried cement/bentonite mixture as the reagent to treat the contaminated soils. The representative treated soil was collected and tested to ensure meeting the cleanup criteria. A soil cap was installed over the remediated area at completion of the ISS activities.

Honeywell Impacted Material Excavation - Moundsville, WV
Ms. Liu was the Project Engineer for this impacted material removal and disposal project. The project activities included the excavation and stabilization/solidification of the impacted materials from the seven Solid Waste Management Units (SWMUs) which occupied approximately 44 acres in area. Fly ash and lime were utilized as stabilization/solidification reagents. The stabilized/solidified impacted materials were transported and placed into the on-site synthetic lined landfill for the final disposal. Ms. Liu performed field oversights and tests to ensure all activities have met the construction design criteria and specifications. Ms. Liu also prepared the Final Closure Report and the Operation and Maintenance Plan for this project.

US Army Corps of Engineers - St. Louis, MI
Ms. Liu evaluated the excavation stability for acceptable slope angles and supported via sheet pilings, and prepared project specifications and construction drawings.

New York State Department of Environmental Conservation - Wellsville, NY
Ms. Liu was a QA/QC Engineer for Wellsville/Andover landfill project in Wellsville, New York. She performed QA/QC oversight for installation of a leachate collection system, a pump station, force main and storage tanks, for relocation and consolidation of a waste and for installation of a landfill cap and piezometers/wells.

Port of Seattle - Seattle, WA
Ms. Liu was the Project Engineer for the Port of Seattle project in Seattle, Washington. She provided QA/QC oversight during installation of a slurry wall measuring 1,650-feet long and averaging between 33- and 50-feet deep. In addition, she provided oversight on construction of a 1,000-foot-long LNAPL recovery trench with an average depth of 16 feet.

Orote Power Plant - US Navy, Guam
Ms. Liu was a QA/QC engineer for the U.S. Navy at the Orote Power Plant project in Guam during installation of a diesel fuel collection trench and a groundwater treatment plant to treat diesel fuel contamination. In addition to QA/QC work, also trained local laborers to make and dispense the slurry, performed site surveying and staking, took direct responsibility for establishing crew assignment and the sequence of work, and estimated material quantities and established schedules for delivery of both materials and equipment.

Marathon Battery - Cold Springs, NY
Ms. Liu was a Project Engineer for sheet piling installation for USACEKC at the Marathon Battery Superfund site in Cold Springs, New York. She provided QA/QC oversight and engineering support during sheet piling installation as part of the pier reconstruction.

Helen Kramer Landfill - Mantua Township, NJ
Ms. Liu was a QA/QC engineer and field engineer for the USACE-Philadelphia District at the Helen Kramer Landfill Superfund site in Mantua Township, New Jersey, during slurry wall installation and landfill capping. She provided QA/QC oversight throughout installation of an 8,200-foot-long slurry wall and placement of an 80-acre multilayer landfill cap at this site, listed No. 4 on the U.S. Environmental Protection Agency's (EPA) National Priorities List.

Panoche Landfill - Solano County, CA
Ms. Liu was a Project engineer for slurry wall construction at IT's Panoche Landfill in Solano County, California. Provided QA/QC oversight and engineering support during slurry wall installation as part of the closure design for this Resource Conservation and Recovery Act (RCRA) Class I landfill.

Oxy-Chem - Niagara Falls, NY
Ms. Liu was a Project engineer providing technical support during construction of a leachate collection trench for Occidental Chemical Corporation at their Niagara Falls, New York.

EDUCATION

Ph.D., Civil Engineering - University of Cincinnati, Cincinnati, OH, 1988
M.S., Civil Engineering - University of Cincinnati, Cincinnati, OH, 1979
B.S., Civil Engineering - Tamkang University, Taiwan, 1977

TRAINING AND CERTIFICATIONS

OSHA 29 CFR 1910.120 40-Hour HAZWOPER Training
8 Hour Hazwoper Refresher
8 Hour Supervisor Safety Training
Defensive Driving
Mine Safety and Health Administration (MSHA) Training
General Contractor for the US Navy

Steve Liatti, P.E.

ENTACT

REMEDIAL DESIGN: S/S LEAD
REMEDIAL ACTION: TECHNICAL ADVISOR
2006 - Present

Mr. Liatti is a Pennsylvania state registered professional engineer and has over 14 years of experience working on a variety of environmental remediation and construction projects. As a Project Engineer at ENTACT, Mr. Liatti is responsible for quality assurance/quality control measures, field engineering, and ensuring construction activities are being performed in accordance to project specifications. Mr. Liatti's experience includes installation of groundwater extraction wells using continuous flight hollow stem auger drill rigs, percussion drill rigs, and hammer drill rigs; construction of groundwater collection trenches and bentonite slurry cut-off walls; soil and sludge stabilization; cap construction; performing soil, concrete and alpha testing; and various other scopes.

ENTACT EXPERIENCE SUMMARY

Active Refinery Tank Pads - MS
Mr. Liatti is the field engineer for subsurface soil treatment at this active refinery that is currently undergoing expansion. ENTACT is implementing subsurface ground improvement measures at 16 proposed tank footprints to minimize the potential for future tank foundations settlement. Scope of work includes installing a series of soil-cement columns underneath the planned footprint of each tank foundation. ENTACT is employing (2) In-Situ Vertical Auger Mixing Rigs complete with their respective Grout Batch Plants that will work concurrently in order to accomplish the specified work within the allotted durations. ENTACT designed and implemented a series of treatability studies at our in-house laboratory to determine the optimum reagent and delivery program required to meet project objectives and performance criteria.

Former Research and Marketing and Cable Manufacturing Property - Bayonne, NJ
Mr. Liatti was the Field Engineer for remediation activities at this 65-acre former research and marketing and cable manufacturing property. Scope of work included improving site roads; excavation and load out of 4,000 tons of impacted soil; in-situ and ex-situ (above groundwater) stabilization of lead impacted soil; installation of two-foot soil cover; and revegetation of disturbed areas.

Honeywell SA-7 Excavation/Backfill Project - Jersey City, NJ
Mr. Liatti was a Field Engineer for multi-year activities at this $65M remediation. Scope of work included excavation of approximately 932,000 cubic yards of chromium contaminated soils and other materials, which are classified as hazardous waste. To enable removal activities to occur, ENTACT designed, constructed, and operated a vacuum well point and deep well groundwater extraction system to lower the groundwater elevation and water content of waste materials as much as practicable. Additional activities included installation and abandonment of observation wells, inclinometers, and piezometers, as well as protection and abandonment of several existing monitoring wells. Site restoration included the supply, placing, and compacting of approximately 880,000 cubic yards of imported backfill.

COPR Soil Remediation - Jersey City, NJ
Mr. Liatti was the QC Engineer for an additional phase of work at this large chromium soil remediation project. The complexity of the project was based on a temporary soil retention system in support of the excavations which are directly bounded on two sides by active city streets. Scope of work for this project included: demolition and size reduction of surface asphalt, concrete and other structures; installation of a drop tube "nested" well point dewatering system comprised of 69 vacuum pressure wells to reduce the moisture content of impacted soils; pre-excavation of the perimeter sheet pile wall alignment to 10 feet below ground surface (bgs) to remove obstructions and exotic materials, and minimize the impacts of vibration; real time seismograph vibration monitoring of utilities and surrounding structures; and installation of a soil retention perimeter sheet pile wall driven to a depth of 22 feet to also effectively reduce a continuous in-flow of groundwater to the excavation pit.

Upon completion of the sheet pile installation, ENTACT conducted the phased removal of 5,560 cubic yards of hazardous soils, and 2,850 cubic yards on non-hazardous soils; load out of impacted materials; and site backfill and restoration.

Confidential NPL Site - Carlstadt, NJ
Mr. Liatti was the on-site Field Engineer for this NPL Site remediation. This Site once housed a former industrial waste handling, treatment and disposal facility. Our scope of work included installation of a 600 linear foot sheet pile wall to an average depth of 42 feet along Peach Island Creek; demolition of buildings and structures; construction of a groundwater recovery system (vertical wells, horizontal headers, leachate collection tank, and building); and partial installation of a site wide cap consisting of geosynthetic clay liner, 40 mil geomembrane, geocomposite drainage layer, 18 inches of common fill, 6 inches of vegetative cover soil. To address the hot spot area, ENTACT completed a Field Verification Program (FVP) of the In-situ Air Stripping and In-situ Stabilization (ISAS/ISS) using our Delmag RH-32 Deep Soil Mixing Drill Rig equipped with an 8-foot diameter auger and 40 foot long kelley bar. The system collected emissions using a custom 10-foot diameter shroud designed and fabricated by ENTACT operating under negative pressure for collection and treatment of particulates and VOC emissions.

Former Gasoline Manufacturing Plant/Distillation Facility Remediation - Majorsville, PA
Mr. Liatti was the on-site Field Engineer for this project. ENTACT was contracted to complete Deep Soil Mixing (DSM) via in-situ grout injection of approximately 20,000 cubic yards of light non-aqueous phase liquid (LNAPL) impacted soil and sediment resulting from historical MGP operations on site. Major scope activities included the construction of a perimeter barrier wall around two cells (Cell 1 and Cell 2) by way of ISS using our company-owned Delmag RH-32 drill rig and 8 foot auger; excavation and placement of LNAPL impacted soils from an adjacent stream bank/stream bed, followed by ISS of up to 17 feet of these and other impacted soils from within the cells; stream bank armoring by way of 24 inch rip-rap installation; and subsequent asphalt capping of the entire site. Additional activities included dewatering and on-site water treatment (metals, VOC's, LNAPL), installing a Portadam unit along 650 lineal feet of the stream to enable remediation of the stream bank and bottom; installation of an interceptor trench and exfiltration gallery to alleviate groundwater mounding around the newly created monolith; construction of a storm water retention swale and berms; and seeding and mulching all affected areas.

ENTACT developed the mix design for the full scale remediation in our in-house treatability laboratory. This design utilized a cement grout, supplemented with bentonite to deliver a stabilized end product with an unconfined compressive strength of 50 psi, overall permeabilities less than 1×10^{-6} cm/sec, and no visible sheen.

Active Terminal Remediation - Bayonne, NJ
Mr. Liatti was the QC Technician for quality control measures for the remediation of a significant portion of the Platty Kill Canal (a tidally influenced body of water) known as the North Cell. Prior to project start-up, ENTACT completed an exhaustive bench scale treatability to select reagents capable of stabilizing the sediments and producing the required strength and permeability for an interior and perimeter mix requirement. A full scale pilot test was then performed using the mix designs identified in the bench scale treatability. Sediment cells of 100 cubic yards were established to perform trial mixing of the successful bench-scale mix designs.

ENTACT installed sheet pile to isolate the canal from the remainder of Platty Kill and installed dewatering pumps to maintain water in-leakage within the canal. Approximately 12,000 cubic yards of onsite impacted soils were selected and relocated to the canal for inclusion in the interior mix. Onsite soils were mixed using a hydraulic excavator, followed by slurried Portland cement using a Lang Tool for mixing as deep as 18-20ft. As the interior cells progressed, the perimeter cells followed using a hydraulic excavator to add the low-perm clay material with dry bentonite, followed by slurried bentonite using a Lang Tool. The completed stabilized sediment was capped with additional onsite soils, and a perimeter interceptor trench with vertical sumps was installed. The cell was covered with a GCL-based geomembrane cover system and seeded.

Mine Tunnel Superfund Site - Confidential Location, PA
Mr. Liatti was the Technical Lead comprising the Operations and Maintenance Manual for the Emergency Response System for this site. ENTACT was responsible for overseeing the building of infrastructure to monitor and respond to any future spill events from this mine tunnel outfall that discharges into a local river. Activities included procurement of spill response equipment and supplies; installation of stake piles in the river bottom; construction of an emergency access road and boat ramp; construction of an off-site warehouse for storage of spill response equipment and supplies; design and installation of an automated mine and weather conditions monitoring system to detect and report potential and imminent releases; training Response Personnel; preparation of O&M Manuals; and execution and coordination of a large community information program consisting of business posters, direct mail, radio and newspaper advertisements, and a post campaign survey.

PREVIOUS EXPERIENCE

Exxon Bayway Sludge Lagoon Operable Unit Remediation Project - Linden, NJ
This design build project involved bench-scale treatability testing to select reagent admixtures for each of 14 sludge lagoons at the site. Mr. Liatti was responsible for the admixture selection and percentages used based on the bench-scale testing program. The construction phase involved the closing of the sludge lagoons as well as other major site work including solidifying over 100,000 cubic yards of sludge in the lagoons with Portland cement and fly ash; construction of two 1,000,000 gallon storm water detention basins with conveyance piping; installation of a 141,000-square-foot soil-bentonite cut-off wall; driving 120 linear-feet of waterproof sheet piling serving as a portion of the cut-off wall; installation of 6,600 linear feet of groundwater collection trench; and construction of a 40-acre soil cap with storm water control features.

Richardson Hill Road Landfill - Sidney Center, NY
Mr. Liatti oversaw the construction of a 1,200-linear-foot 35,000-square-foot groundwater collection trench backed with a 40-mil HDPE liner on the down gradient side to prevent migration of PCB contaminated groundwater into a nearby trout stream. He worked with a union labor force to setup a slurry mixing plant and performed slurry quality assurance and quality control testing during trench construction. He was also responsible for the installation of three groundwater collection sumps and pumps and associated piping to convey contaminated collection trench water to an on-site treatment plant.

Liberty National - Jersey City, NJ
Mr. Liatti oversaw the construction of a 1000-linear-foot 25,000-square-foot soil-bentonite slurry cut-off wall. The wall was constructed to stop the migration of chromium contaminated groundwater from leaching into the Hudson River in Jersey City, NJ. His duties also included conducting all of the necessary slurry and backfill quality control tests to ensure the cut-off wall was being constructed in accordance with project specifications.

Chevron - Perth Amboy, NJ
Mr. Liatti oversaw the construction of a 900-linear-foot 18,000-square-foot soil-bentonite slurry cut-off wall. The wall was constructed to stop the continued migration of petroleum contaminated groundwater beyond the refinery property line. His duties also included conducting all of the necessary slurry and backfill quality control tests, and to develop a Portland cement mix design to stabilize the project's residual bentonite slurry.

Impoundment 26 Closure - Bound Brook, NJ
Mr. Liatti served as project engineer on this remediation site involving solidification of 25,000 cubic yards of contaminated soil using a pugmill. He was responsible for solidified soil sample preparation/evaluation and recommended admixture quantity adjustments based on sample results.

Fernald FEM Project, U.S. DOE - Cincinnati, OH
Mr. Liatti oversaw a crew of 8 union pipe fitters responsible for the installation of an underground piping system in support of a wastewater treatment plant at the Fernald Department of Energy project site. The underground system consisted of over five miles of pipe connecting several facilities making up the treatment plant's influent. He was also responsible for performing quantity take offs and placing orders for all the required tools and materials needed to complete the project.

American Creosote - Winnfield, LA
Mr. Liatti executed a number of tasks at a former creosote plant including working with contractors to construct a 2000 linear-foot 60,000 square-foot groundwater collection trench containing 6 groundwater collection sumps; a 1,000,000 gallon storm water detention basin; installation of 15 groundwater collection wells, pumps and associated piping to convey creosote contaminated water to an on-site treatment facility; conducted quantity surveys of material excavated and hauled to an on-site incinerator; and oversaw the construction of a 1.5-acre landfill cap.

Times Beach Remediation Project - Times Beach, MO
Mr. Liatti worked with a union labor force installing a treatment plant piping system to treat scrubber water generated from an on-site incineration unit processing dioxin contaminated soils. He was responsible for obtaining all materials and completing the installation on schedule. Mr. Liatti also evaluated the bearing surface of the incinerator foundation prior to concrete placement and conducted the required concrete quality assurance and quality control testing.

EDUCATION

B.S., Civil Engineering - University of Cincinnati, Cincinnati, OH

M.S., Civil Engineering - University of Cincinnati, Cincinnati, OH

TRAINING AND CERTIFICATIONS

Professional Engineer, State of Pennsylvania
OSHA 29 CFR 1910.120 40-Hour HAZWOPER Training
OSHA 29 CFR 1910.120 8-Hour HAZWOPER Refresher (annual)
LPS Loss Prevention System Training
Hazwoper Supervisor Safety Training
OSHA Excavation and Trenching Competent Person Training
U.S. Department of Energy, RAD 11Worker Certified
Defensive Driving
OSHA 10-Hour Construction Safety

Geosyntec
consultants

GREGORY T. CORCORAN, P.E.

site investigation and remediation
brownfields redevelopment planning and design
waste containment facility planning and design
geotechnical infrastructure/foundation engineering

EDUCATION

M.S., Civil Engineering, Drexel University, Philadelphia, Pennsylvania, 1994
B.S., Civil Engineering, Drexel University, Philadelphia, Pennsylvania, 1992

REGISTRATIONS AND CERTIFICATIONS

Professional Engineer, California, No. C58876
Professional Engineer, Oregon, No. 65140PE
Professional Engineer, Arizona, No. 37705
Professional Engineer, Utah, No. 6020077-2202
General Engineering Contractors License A, California, No. 766859
Hazardous Substances Removal Contractors License, California, No. 766859

CAREER SUMMARY

Mr. Greg Corcoran, PE, principal civil engineer based in California, focuses on the design, construction, and operation of engineered systems for waste containment and site development at locations impacted by the presence of contaminants in soil, soil gas, and groundwater. Specializing in the design and construction of liner and cover systems for waste containment facilities for more than 20 years, Mr. Corcoran has been involved with the design and/or construction of containment systems, both final cover and base liner, for more than 60 landfills at sites throughout the United States utilizing the latest advances in geosynthetic, recycled, and natural material technology applications. In addition, with more than 30 completed projects at contaminant-impacted sites, he is a leader in the application of remediation technologies such as vapor barrier, soil vapor extraction (SVE), dual phase extraction (DPE), pump and treat, excavation and removal, chemical oxidation, bioaugmentation, and natural attenuation at environmentally-impacted sites allowing redevelopment to occur (Brownfields sites). He continues to advance the state-of-the-practice by developing systems that allow the construction of commercial space on top of closed landfills and other impacted sites. He is the co-developer of a patented system designed to detect and prevent migration of subsurface gases into buildings. Mr. Corcoran also serves on several American Society of Testing and Materials (ASTM) D35 subcommittees for preparation and approval of ASTM standards and test methods relating to geosynthetic materials. Mr. Corcoran is a registered professional engineer in California and other states. He also holds a

California General Engineering Contractors License and a Hazardous Substances Removal Contractors License allowing him to deliver remediation system projects through the design/build/operate (DBO) process. Mr. Corcoran earned his Masters and Bachelors of Science degrees in civil engineering from Drexel University in Philadelphia, Pennsylvania.

Brownfields Redevelopment Planning and Design

Landfill Development, Elings Park Foundation, *Santa Barbara, California.* Engineer of Record for design peer review for vapor barrier beneath a new structure adjacent to the landfill.

Brownfield Development, Home Depot*, Huntington Beach, California.* Engineer of Record for the design and construction of a vapor barrier beneath a new retail development.

Brownfield Development, 901 San Antonio*, Palo Alto, California.* Engineer of Record for the design and construction of a vapor barrier beneath a new mixed use development.

Brownfield Development, Target Corporation*, Hayward, California.* Engineer of Record for the construction of a vapor barrier beneath a new retail development.

Brownfield Development, Skywest Commons Retail Center, *Hayward, California.* Engineer of Record for the design and construction of a vapor barrier for the construction of five new retail buildings totaling over 200,000 square feet.

Brownfield Development, Confidential Client, *Mountain View, California.* Design Manager for the design and construction of a gas monitoring and control system, consisting of a gas extraction system and gas monitoring system for the construction of a mixed use residential, commercial, and parking structure.

Brownfield Development, Slough Estates, South San Francisco, California. Design Manager for the design of a gas monitoring and control system, consisting of a gas barrier, gas extraction system, and gas monitoring system for the construction of eight new multi-story office buildings and two parking structures. Mr. Corcoran was responsible for interfacing with DTSC, preparation of a methane gas mitigation plan; construction level drawings; construction quality assurance plan; operation, maintenance, and monitoring plan; and technical specifications.

Brownfield Development, Confidential Client, *Long Beach, California.* Design Manager for the development of a former manufacturing site into a residential and

commercial, mixed use facility. Mr. Corcoran provides conceptual design and cost estimating services for the purposes of planning the development of the facility to optimize property use in conjunction with engineering controls associated with residual contaminants. Project Manager and Engineer of Record for preparation of construction specifications, design review, and construction oversight of vapor control systems for 250 acre redevelopment site.

Brownfield Development, Boeing Realty Company, *Los Angeles, California.* Engineer of Record for the design and construction of a vapor barrier system, consisting of a high density polyethylene geomembrane for the construction of a new light industrial building.

Landfill Redevelopment, Confidential Client, *Carson, California.* Prepared the conceptual design of environmental aspects of site redevelopment associated with constructing large buildings and parking structures on a landfill. Environmental components included final cover system, landfill gas extraction and treatment system, surface water control system, groundwater treatment system, foundation systems comprised of piles, pavement systems, and building protection systems including geomembrane vapor barrier and passive vapor extraction for over 500,000 square feet of building footprint. In addition to the conceptual design, elaborate capital and long-term cost analyses were prepared to account for the additional costs associated with redeveloping this site, given the environmental and geotechnical constraints associated with the landfill.

Brownfield Development, Home Depot, *Monterey Park, California.* Project Manager and Engineer of Record for design of a gas monitoring and control system, consisting of a gas extraction system and a real-time gas monitoring system for the construction of a new retail store. Mr. Corcoran was responsible for preparation of design calculations, construction level drawings, technical specifications, operation and maintenance and monitoring plan, and a final construction report upon completion of the construction.

Brownfield Development, Home Depot, *Oregon City, Oregon.* Project Manager and Engineer of Record responsible for design and construction of a gas monitoring and control system, consisting of a geomembrane gas barrier (spray applied geomembrane), an active gas extraction system, and a real-time gas monitoring system for the construction of a new retail store. Mr. Corcoran was also responsible for preparation of design calculations, construction level drawings, technical specifications, operation and maintenance and monitoring plan, and a construction quality assurance report upon completion of the construction.

Landfill Redevelopment, Confidential Client, *Phoenix, Arizona.* Project manager for the preparation of construction cost estimates and the evaluation of the viability of

several post-closure development options for two landfill properties. Mr. Corcoran prepared a detailed construction cost estimate for landfill related items required for several development options, reviewed project files obtained from the regulatory agencies, participated in a meeting with regulatory officials, and participated in several team meetings.

Brownfield Development, Extended Stay America Hotel, *San Jose, California.* Conducted the peer review of a gas monitoring and control system for the construction of a new hotel within 1,000 feet of a landfill. Mr. Corcoran was selected by the Local Enforcement Agency (LEA) to provide a peer review of the engineering design. As the Project Manager and Peer Reviewer, Mr. Corcoran is responsible for interfacing and communicating with the client, the design engineer, preparing a letter report summarizing the recommended changes to the proposed system, and providing construction support.

Brownfield Development, 235 on Market Street/UNOCAL, *San Diego, California.* Project Manager and Engineer of Record for the design and construction of a vapor control system, consisting of vapor monitoring, vapor barrier (spray applied geomembrane), and vapor extraction systems beneath the structure. In addition, the project included preparation of an operating, maintenance, and monitoring plan and providing vapor monitoring services for the completed vapor control system. Mr. Corcoran was also responsible for preparation of design calculations, construction level drawings, technical specifications, operation, maintenance, and monitoring manual, the construction quality assurance plan, and construction quality assurance.

Brownfield Development, California Polytechnic University AGRIScapes Project, *Pomona, California.* Project Manager for the design of a gas monitoring system, consisting of vertical gas monitoring wells adjacent to the proposed structures and horizontal gas monitoring probes beneath the proposed structures. Prepared construction level drawings and technical specifications.

Brownfield Development, Home Depot, *Tucson, Arizona.* Project Manager for the design and permitting of a gas monitoring and control system, consisting of gas monitoring wells, horizontal and vertical gas extraction systems, and a real-time gas monitoring system, for the construction of a new retail store. In addition, the project involved preparation of several alternative approaches to the environmental conditions on the site, including engineer's estimates, and preparation of a final cover system conceptual design for permitting purposes. Mr. Corcoran was responsible for preparation of design calculations, construction level drawings, technical specifications, a monitoring and reporting plan, an operation and maintenance plan, and a contingency plan.

Brownfield Development, Home Depot, *Honolulu, Hawaii.* Project manager for the design and construction of a gas monitoring and control system, consisting of a geomembrane gas barrier, an active gas extraction system, and a real-time gas monitoring system for the construction of a new retail store. In addition to serving as Project Manager, Mr. Corcoran was responsible for preparation of design calculations, construction level drawings, technical specifications, monitoring and reporting plan, operation and maintenance plan, and contingency plan, and a construction quality assurance report upon completion of the construction.

Building Protection System Evaluation and Monitoring, *Confidential Client, California*. Project Manager responsible for evaluation of an existing gas barrier and gas control system located beneath a building where high levels of gas presented problems. The evaluation consisted of a carefully executed gas monitoring program and the evaluation of the design basis and methods utilized to construct the gas barrier and gas control system. Recommendations for the remediation and repair of the troublesome gas barrier and gas control system were presented to the client.

Brownfield Development Construction, Peck/Jones and Hoag Hospital, *Newport Beach, California.* Project Manager for construction quality control of a HDPE geomembrane gas barrier and gas monitoring system beneath a new multi-level building and parking structure.

McColl Superfund Site Remediation CQA, McColl Site Group, *Fullerton, California.* The McColl Superfund Site is a former waste disposal area that is now developed into a golf course. Remediation of the site involved the construction of a geosynthetic final cover system consisting of a HDPE geomembrane, GCL, geocomposite, geotextile, geogrid, piping, concrete, and earthen components. Mr. Corcoran served as a lead CQA monitor for certain key elements of the geosynthetic installation.

Site Investigation and Remediation

Former Aerospace Manufacturing Facility, Confidential Client, *Long Beach, California.* Project Manager, Engineer of Record, and General Contractor for design, permitting, and implementation/construction of groundwater remediation consisting of in-situ chemical oxidation (ISCO), pump and treat, and enhanced in-situ biodegradation (EISB) for chlorinated chemicals at depths greater than 45 feet below ground surface. In addition, environmental infrastructure associated with contingency pump and treat system was designed and constructed. Project involved obtaining both General and Individual WDRs for the remediation.

Former Aerospace Manufacturing Facility, Confidential Client, *Long Beach, California.* Project Manager and Engineer of Record for design, permitting, and construction oversight of environmental infrastructure associated with contingency

pump and treat systems, consisting of double wall high density polyethylene pipe, single wall HDPE pipe, and PVC conduit for power and control wiring.

Former Aerospace Manufacturing Facility, Confidential Client, *Burbank, California.* Project Manager and Engineer of Record for design, permitting, and implementation/construction of soil vapor remediation system for chlorinated chemicals at depths greater than 175 feet below ground surface. In addition, coordination with developer of site was necessary for successful implementation of remediation system.

Former Pesticide Distribution Site Remediation, Unocal, *Brawley, California.* General Contractor and Engineer of Record for the design, permitting, and implementation of an excavation and removal of approximately 13,000 cubic yards of pesticide impacted soils from an adjacent property. Impacted soils were excavated and removed, while imported fill material was placed and compacted to original grade. Mr. Corcoran served as the general contractor for the implementation of the project.

Manufacturing Site Remediation, Hewlett-Packard*, San Diego, California.* Project Manager and Engineer of Record for the design, construction, and operation of a soil gas remediation system consisting of a soil vapor extraction system consisting of two extraction wells and a granular activated carbon vapor treatment system, routine groundwater monitoring, and in-situ chemical oxidation remediation.

San Marcos II Landfill Remediation, County of San Diego, *San Marcos, California.* Conducted the assessment of an existing corrective action system, preparation of a revised operation and maintenance manual, revisions to the corrective action system piping, design and installation of a groundwater treatment system, and operation and maintenance of the groundwater remediation system. In addition, leachate production modeling using the HELP Model was performed to verify quantity of leachate effluent from the lined portion of the landfill.

Former Manufacturing Site Remediation, Home Depot, *Burbank, California.* Engineer of Record for the design and construction of the following: a 55 feet deep, 3,000 feet long soil bentonite slurry wall; a shallow soil vapor extraction system (SVE); a deep SVE system, a deep dual phase extraction system (DPE); and treatment systems for three effluent sources. As design manager, Mr. Corcoran was responsible for design and construction oversight/support services.

Former Manufacturing Site Remediation, K-Tube Corporation, *San Diego, California.* Project Manager and Engineer of Record for site assessment and preparation of a feasibility study for remedial measures associated with chlorinated solvent impacts to soil, soil gas, and groundwater. Various remedial measures were considered, including permeable reactive barriers, permanganate, excavate and removal, groundwater pump and treat, dual phase extraction (DPE) and treatment, and monitored

natural attenuation. Detailed cost analyses were prepared and used by the client to account and budget for the remediation costs. Managed design, construction, and operation of DPE remedial equipment and 5 extraction wells for the remediation of chlorinated solvent impacts in soil, soil gas, and groundwater. The treatment system was comprised of a granular activated carbon, acid dosing to reduce carbonate fouling, and mechanical filtration. The remediation system was successfully operated for a period of 2-years, with a run time efficiency of 92%, and removed approximately 187 pounds of volatile organic chemicals. The total capital and operation related costs did not exceed the cost estimate prepared as part of the feasibility study and used by the client for budgeting. Mr. Corcoran was responsible for preparation of design calculations, construction level drawings, technical specifications, operation and maintenance and monitoring plan, and a final construction report upon completion of the construction.

Palomar Airport Landfill Remediation Feasibility Study, County of San Diego, *Carlsbad, California.* Estimated design, construction capital, monitoring, and operation and maintenance costs for several groundwater/surface water seep remediation alternatives for a municipal solid waste landfill. Remediation alternatives included collection and treatment, groundwater pump and treat, and vertical barrier. In addition, a feasibility study was prepared for groundwater remediation at each of the three landfill units at the site. Remediation alternatives included pump and treat, biological enhancement, and zero valent iron permeable reactive barrier.

San Pasqual Landfill Feasibility Study, County of San Diego, *Escondido, California.* Estimated design, construction capital, monitoring, and operation and maintenance costs for several remediation alternatives for both a burn ash and a municipal solid waste landfill at the site. Remediation alternatives included clean-closure and final cover system installation.

Sycamore Landfill Groundwater Monitoring, San Diego Landfill Systems, Allied Waste, *San Diego, California.* Project Manager for performing groundwater monitoring and maintenance of six monitoring wells and one corrective action pumping well at an active landfill. Semi-annual reports include time series plots of chemical concentrations, groundwater elevation contour maps, tables summarizing groundwater data, and description of sampling activities.

Ramona Landfill Groundwater Monitoring, San Diego Landfill Systems, Allied Waste, *Ramona, California.* This project involves performing groundwater monitoring and maintenance of five monitoring wells and four corrective action pumping wells at an active landfill. Semi-annual reports include time series plots of chemical concentrations, groundwater elevation contour maps, tables summarizing groundwater data, and description of sampling activities.

Waste Containment Facility Planning and Design

Fly Ash Disposal Dust Mitigation, Design; Propex Operating Company, *Fruitland, New Mexico.* This project involved the design of a Pyramat cover anchoring system to secure Pyramat material to the surface of exposed side slopes of fly ash for the purpose of minimizing dust generation. Design accounted for 60 mph wind speeds. As Project Manager, Mr. Corcoran was responsible for interfacing and communicating with the client, staffing, budgeting, scheduling, and Design Report preparation.

Emery Landfill Slurry Wall Containment, Design and CQA; Remedial Construction Services (RECON), *Wichita, Kansas.* This project involved the design and CQA for the installation of a 4,000 foot long and 30 foot deep soil bentonite slurry wall and earthen final cover system extension. As the Project Manager, Mr. Corcoran was responsible for interfacing and communicating with the regulatory agencies and client, staffing, budgeting, scheduling, and design report preparation, construction technical specifications and drawing preparation, and CQA Report preparation.

Bradley West Landfill Closure, CQA; Waste Management, *Sun Valley, California.* This project involved the construction quality assurance for the construction of a approximately 130 acre final closure construction consisting of an evapotranspirative, monolithic soil cover. As the Project Manager and Engineer of Record, Mr. Corcoran is responsible for interfacing and communicating with the regulatory agencies, client, staffing, budgeting, scheduling, and CQA Report preparation.

Grassy Mountain Landfill Closure, Clean Harbors, *Tooele County, Utah.* Geosyntec revised the existing CQA Plan to incorporate current testing standards and methods for the geosynthetic and soil based final closure.

Buttonwillow Class II Landfill Closure, WMU18, 21, 22, 23, and 27; Clean Harbors, *Buttonwillow, California.* This project involved the design of a sludge solidification program, evapotranspirative soil cover for five separate non-hazardous waste management units. As the Project Manager and Engineer of Record, Mr. Corcoran is responsible for interfacing and communicating with the regulatory agencies, client, staffing, budgeting, scheduling, design report and drawing preparation, closure report preparation, and construction quality assurance plan preparation.

Buttonwillow Class I Landfill Closure, WMU35, Cell 1 Construction Management and CQA; Clean Harbors, *Buttonwillow, California.* This project involved the construction management and construction quality assurance for the construction of a 6 acre final closure construction consisting of a single composite liner system. As the Project Manager and Engineer of Record, Mr. Corcoran is responsible for interfacing

and communicating with the regulatory agencies, client, staffing, budgeting, scheduling, and construction meeting attendance.

Buttonwillow Class I Landfill, WMU35, Cell 3 Construction Management and CQA; Clean Harbors, *Buttonwillow, California.* This project involved the construction management and construction quality assurance for the construction of a 10 acre horizontal expansion consisting of a double composite liner system. As the Project Manager and Engineer of Record, Mr. Corcoran is responsible for interfacing and communicating with the regulatory agencies, client, staffing, budgeting, scheduling, and construction meeting attendance.

Prima Deschecca Landfill, Zone 4 Design and Permitting, *San Clemente, California.* This project involved the geotechnical and hydrogeologic investigation and landfill design and permitting. As technical manager, Mr. Corcoran was responsible for managing the technical elements of the project.

Elings Park, Engineering Design and Permitting; Elings Park Foundation; *Santa Barbara, California.* Engineer of record for the design and permitting of an engineered alternative final cover system for an eight acre portion of a landfill that is being redeveloped as a regional park. Geosyntec is providing conceptual design services related to the final cover system.

Corrective Action Management Unit (CAMU); Engineering Design and Construction; Basic Remediation Company; *Henderson, Nevada.* Project manager for the design and permitting of a 52 acre composite lined landfill sized to accommodate over 3.4 million cubic yards of sludge and impacted soils from areas of the site. The design involved base liner system, waste excavation and processing, waste placement in the CAMU, and final cover system. In addition, approximately 200,000 cubic yards of hazardous waste materials were excavated in Level B personal protective equipment. Geosyntec prepared stability, liner system design, and leachate collection system design calculations. Design report, CQA Plan, Technical Specifications, design analyses, and design drawings were prepared and submitted to the Nevada Division of Environmental Protection (NDEP) for approval. Geosyntec is also providing construction quality assurance and construction management support services during construction of the CAMU.

Kettlemen Hills Facility, Engineering Design; Chemical Waste Management; *Kettlemen Hills, California.* This project involved the design and permitting of the B-19, Cell A-1 disposal area, which includes approximately 20 acres of lined area and approximately eight hundred thousand cubic yards of excavation. Design report, CQA

Plan, Technical Specifications, design analyses, and design drawings were prepared and submitted to the Regional Water Quality Control Board for approval.

Kettlemen Hills Facility, Joint Technical Document; Chemical Waste Management; *Kettlemen Hills, California.* The project involved the preparation of a Joint Technical Document for a new disposal area at the landfill facility.

El Sobrante Landfill, Engineering Design; Waste Management; *Corona, California.* This project involved the design and permitting of the Phase 9 disposal cell, which includes approximately 40 acres of lined area and approximately 5 million cubic yards of soil and rock excavation. Design report, CQA Plan, Technical Specifications, design analyses, and design drawings were prepared and submitted to the Regional Water Quality Control Board for approval.

Buttonwillow Facility, WMU 35 RCRA Part B Permit; Clean Harbors; *Buttonwillow, California.* This project involved the design and permitting of the remainder of the disposal cells associated with waste management unit (WMU) 35. Static and seismic slope stability and leachate collection and removal system design analyses were performed to support the RCRA Part B permit application. In addition, revisions were made to the Design Report, CQA Plan, and Technical Specifications.

Olinda Alpha Landfill Additional Reservoir Capacity; County of Orange Integrated Waste Management Department; *Brea, California.* This project involves the construction management of the installation of a one mile long, three lane wide asphalt paved access road and a 100,000 gallon steel, above ground water tank and associated piping, fittings, valves, and other appurtenances.

Antelope Valley Landfill, Phase V-A-1 Expansion; Waste Management; *Palmdale, California.* This project involves the construction of a 6 acre and 4 acre landfill liner system expansions consisting of over 800,000 CY of compacted fill, clay liner, geomembrane, geocomposite, pipe, gravel, geotextile, and operations layer materials. A compacted clay liner test pad was constructed from on-site soils and tested for hydraulic conductivity using a sealed double ring infiltrometer test (SDRI).

El Sobrante Landfill, Partial Final Closure, Waste Management; *Corona, California.* This project involves the construction of a earthen cover (evapotranspirative cover) test pad from on-site soils and testing material properties, compaction, and hydraulic conductivity. In-situ (Boutwell and BAT) tests were performed along with collection in-situ soil samples, using of thin wall samplers, for laboratory testing.

Thomas Ranch Site, The Companies, *Corona, California.* This project involved providing design/build services for the closure of the waste ponds at the site, including the design of final cover and gas control systems for the containment of solid and semi-

liquid waste filled ponds. The cover system consists of geosynthetic clay liner, high density polyethylene geomembrane, and drainage composite. The gas control system consists of both a vertical gas extraction system and a horizontal gas extraction system installed beneath the cover system. As Engineer of Record, Mr. Corcoran was responsible for interfacing with DTSC, coordinating the preparation of calculation packages, design report, remedial construction plan, construction schedule, contingency plan, site management plan, construction quality assurance plan, technical specification, and construction drawings. In addition, GeoSyntec performed general contractor duties along with construction management and construction quality assurance for the construction of the project. As the General Contractor, Mr. Corcoran is responsible for constructing the work and providing construction management, staffing, budgeting and scheduling construction activities.

Buttonwillow Class I Landfill, WMU21 Solidification and Backfill Construction Management and CQA, Clean Harbors, *Buttonwillow, California.* This project involved the solidification of sludge materials within the lined cell through the mixing of petroleum contaminated soils and drying of the materials. As the Project Manager and Engineer of Record, Mr. Corcoran is responsible for interfacing and communicating with the client, staffing, budgeting, scheduling, and construction meeting attendance.

Buttonwillow Class I Landfill, WMU35, Cell 2 Construction Management and CQA; Clean Harbors, *Buttonwillow, California.* This project involved the construction management and construction quality assurance for the construction of a 10 acre horizontal expansion consisting of a double composite liner system. As the Project Manager and Engineer of Record, Mr. Corcoran is responsible for interfacing and communicating with the client, staffing, budgeting, scheduling, and construction meeting attendance.

Kate Valley Landfill, Design Review, Canterbury Waste, *Christchurch, New Zealand.* Performed a design review of the stability analyses for a proposed landfill development project. Two-dimensional and three-dimensional slope stability analyses were performed on various cross-sections to justify the appropriateness of the design approach. Hydration of the geosynthetic clay liner component of the composite liner system was also evaluated due to the impact on slope stability. In addition, a constructability review was performed on the conceptual design.

Savage Canyon Landfill, Phase IIB, Master Planning, and Phase IIB Construction Management and CQA, Whittier Utilities Authority, *Whittier, California.* Provided peer review of a cell design package, including construction documents. Review comments were submitted during the 70%, 90%, and 100% stages of the construction

document preparation. In addition, this project involved the completion of capital cost estimates for future construction of disposal cells, longevity of the site given various waste and daily cover placement rates, and an estimated schedule for future cell construction to accommodate waste placement needs. As the Project Manager and Engineer of Record, Mr. Corcoran was responsible for cost and schedule estimate preparation, constructability review, design review, and communicating with the design engineer and the client. He also was responsible for construction management and construction quality assurance for the construction of an 8 acre horizontal expansion consisting of high density polyethylene geomembrane, geosynthetic clay liner, non woven cushion geotextile, drainage composite, piping, 870,000 CY excavation, 510,000 CY engineered fill placement, and compacted clay liner installation.

Sycamore Landfill Leachate Pumping and Storage System Design, San Diego Landfill Systems, Allied Waste, *San Diego, California.* Project Manager and Engineer of Record for the design of a leachate pumping system, storage tanks, and a concrete secondary containment system. The pumping system was designed using solar panel technology to provide a visible alarm when leachate levels reached a point where the leachate has to be pumped out, at which time a generator is used to provide power to the pumping system. Mr. Corcoran was also responsible for preparation of construction level drawings.

Otay Landfill, Hand Unload Area Improvements and Canyon 3, Phase 3A Disposal Cell CQA, San Diego Landfill Systems, Allied Waste, *Chula Vista, California.* Project Manager and Engineer of Record for construction quality assurance for the construction of a concrete retaining wall and associated asphalt pavement and earthworks construction for a customer unload area and for the construction of a horizontal expansion for a 10-acre municipal solid waste landfill. The expansion utilized an 80-mil thick HDPE geomembrane, geocomposite, piping, and natural soil and aggregate materials.

Pasco Landfill Interim Action Implementation, Landfill Gas Extraction and Treatment System and Final Cover System O&M, PSC, *Pasco, Washington.* This project involves performing operation, maintenance, and monitoring of a landfill gas extraction system consisting of 24 vertical and 2 horizontal extraction wells, a condensate recovery system, a flare, and a condensate flare injection system. The project also entails the routine monitoring and maintenance of a final cover system for a 35 acre municipal solid waste landfill and 4 industrial waste disposal areas (drum and solids disposal areas).

Los Reales Landfill Cell 2 Design and CQA, City of Tucson, Department of Solid Waste, *Tucson, Arizona.* Project Manager and Engineer of Record for design and CQA of a composite bottom liner system, consisting of geosynthetic clay liner, HDPE

geomembrane, cushion geotextile, and natural soil and aggregate materials. Mr. Corcoran was also responsible for preparation of design calculations, construction level drawings, technical specifications, and a construction quality assurance plan.

Sycamore Landfill Waste Excavation, San Diego Landfill Systems, Allied Waste, *San Diego, California.* Project Manager responsible for preparation, permitting, and implementation of a waste excavation plan for the excavation of asbestos containing materials (ACM) and municipal solid waste (MSW) materials. Prepared the waste excavation plan, and managed air monitoring during waste excavation activities.

Sycamore Landfill Liner System Design, San Diego Landfill Systems, Allied Waste, *San Diego, California.* Project Manager and Engineer of Record for the design of a geosynthetic lined expansion of the existing landfill. The bottom liner system consists of GCL, HDPE geomembrane, geosynthetic drainage composite, 32 oz./SY geotextile cushion, and natural soil materials. Responsible for preparation of the design calculations, construction drawings, construction specifications, construction quality assurance plan, and waste fill plan.

Ramona Landfill, Stage III, Phase 3 Disposal Cell CQA, San Diego Landfill Systems, Allied Waste, *Ramona, California.* Engineer of Record for construction quality assurance for the construction of a horizontal expansion for a 5.5 acre municipal solid waste landfill and sedimentation basin, consisting of geosynthetic clay liner, HDPE geomembrane, filtration/cushion geotextile, and natural soil and aggregate materials.

Borrego Landfill Liner System Design, San Diego Landfill Systems, Allied Waste, *Borrego Springs, California.* Project Manger and Engineer of Record for the preparation of conceptual design drawings for a geosynthetic lined expansion, Stage I and Stage II fill plans, cut and fill quantities for both waste and soil materials, and geosynthetic material quantities. In addition to project management, Mr. Corcoran prepared the waste fill plans and quantities.

Landfill Closure and CQA, Philadelphia Department of Aviation, *Philadelphia, Pennsylvania.* Mr. Corcoran served as Geotechnical Engineer on this project, which involved the closure of a landfill Superfund Site to accommodate the construction of a new runway overlying the landfill. Design analyses required for this project included staged construction of an earthen embankment utilizing vertical drains for strength gain of weak soil, slope stability, geotextile design, drainage layer performance, and depth of frost penetration. In addition, settlement of weak soils was accelerated using vertical drains outside of the landfill perimeter and surcharge loading above the landfill final closure. Mr. Corcoran was responsible for construction quality assurance of jet grouting of natural thin clay vertical barrier underlying landfill, as well as the

construction of the final cover system, including geotextile, geonet, LDPE geomembrane, earthworks, and associated appurtenances.

Incinerator Ash Landfill, US Army Corps of Engineers, *Childersburg, Alabama.* Mr. Corcoran served as Design Engineer for the Incinerator Ash Landfill project for the USACE. This project involved slope stability, bearing capacity, settlement analyses, and construction support for a horizontal expansion of the bottom liner and final cover systems for a contaminated soil incinerator ash landfill. The base liner and final cover systems consisted of geotextile, PVC geomembrane, geosynthetic drainage composite, and natural soil materials.

MSW Incinerator Ash Landfill, Connecticut Recovery Authority, *Shelton, Connecticut.* Mr. Corcoran served as Design Engineer for the MSW Incinerator Ash Landfill project for the Connecticut Recovery Authority. He performed slope stability analyses, seismic stability analyses, and liquefaction analyses to determine if a constructed cell would meet the required Subtitle D regulations, which were to be enforced at this site by the state of Connecticut.

Landfill Expansion, Sullivan County, *Monticello, New York.* This project involved designing a horizontal expansion for an existing, double composite lined MSW landfill. Serving as the Geotechnical Engineer, Mr. Corcoran was responsible for liner system design, leachate collection system design (HELP), slope stability, seismic, settlement, and bearing capacity. The bottom liner system consists of HDPE geomembrane, GCL, geotextile, drainage composite, aggregate, and soil materials.

Landfill Closure, Town of Clarkstown, *Clarkstown, New York.* Mr. Corcoran served as Geotechnical Engineer for closure of a 90-acre municipal solid waste landfill. Key design considerations included settlement analyses, tension and veneer stability of the lining system, slope stability, drainage layer performance (HELP model), and depth of frost penetration. The final cover system consisted of geotextile, geosynthetic drainage composite, PVC geomembrane, and natural soil materials.

Landfill CQC, Atlantic County Utilities Authority, *Pleasantville, New Jersey.* Mr. Corcoran served as CQC Engineer responsible for construction quality control of double composite liner system for residual waste landfill. Monitored geosynthetic installation including geotextile deployment and sewn seams; HDPE geomembrane deployment, fusion and extrusion welding, destructive and non-destructive testing; and geonet deployment. Also monitored earthwork construction including nuclear moisture-density testing, sand-cone moisture-density testing, compacted clay liner test pad construction, and Boutwell infiltrometer testing to obtain field permeability of compacted clay liner test pad.

Landfill CQC, Browning-Ferris Industries, *Laytonsville, Maryland.* Mr. Corcoran provided construction quality control of composite liner system for a MSW landfill vertical expansion and two leachate storage lagoons. As Engineering Technician, Mr. Corcoran monitored all aspects of soils construction including all pipe work and manholes associated with both the leachate collection system and the landfill gas collection system. Monitored geogrid, geotextile, geonet, and HDPE geomembrane installation.

Landfill CQA, Waste Management of Pennsylvania, *Morrisville, Pennsylvania.* Responsible for CQA for 10 double lined MSW landfill cells. As Engineering Technician, Mr. Corcoran monitored soil subgrade construction and geosynthetic installation, including HDPE geomembrane, geotextile, geonet, and geosynthetic clay liner installation.

Landfill CQA, Warren County Pollution Control Financing Authority, *Oxford, New Jersey.* Responsible for CQA of double composite liner system for a MSW incinerator ash landfill. As Engineering Technician, Mr. Corcoran monitored geosynthetic installation and soils construction including, bentonite amended soil liner, embankment construction, and leachate collection piping and manholes.

Mining

Arizona 1 Mine Facility, Non Stormwater Pond, Dennison Mines, *Fredonia, Arizona.* This project involved the evaluation of an existing Hypalon chlorosulfonated polyethylene (CSPE) geomembrane. Evaluation consisted of visual inspection, sampling of in-service geomembrane, and testing of geomembrane sample. As Engineer of Record, Mr. Corcoran provided permitting support and certification to the Arizona Department of Environmental Quality.

Pine Nut Mine Facility, Non Stormwater Pond and Ore Storage Pad, Dennison Mines, *Fredonia, Arizona.* This project involved the design of a polyethylene geomembrane and geosynthetic clay liner containment elements for a non stormwater evaporation pond and ore storage pad liner systems. As Engineer of Record, Mr. Corcoran was responsible for preparing technical specifications, construction quality assurance plan, construction drawings, and design report for submittal to the ADEQ.

Canyon Mine Facility, Non Stormwater Pond and Ore Storage Pad, Dennison Mines, *Flagstaff, Arizona.* This project involved the design of a polyethylene geomembrane and geosynthetic clay liner containment elements for a non stormwater evaporation pond and ore storage pad liner systems. As Engineer of Record, Mr. Corcoran was responsible for preparing technical specifications, construction quality assurance plan, construction drawings, and design report for submittal to the ADEQ.

White Mesa Mill, Engineering Design and Construction; Denison Mines (USA) Corp.; *Blanding, Utah.* Engineer of record for the design, permitting, and construction of the Cell 4B surface impoundment, which includes approximately 40 acres of lined area for the evaporation of very low pH process liquids and disposal of mill tailings. Geosyntec prepared action leakage rate (ALR), stability, liner system design, leak detection system design, and slimes drain design calculations. Design report, CQA Plan, Technical Specifications, design analyses, and design drawings were prepared and submitted to the Utah Department of Environmental Quality (UDEQ) for approval. Geosyntec is also providing construction quality assurance and construction management services during construction of the surface impoundment.

White Mesa Mill, Engineering Design and Construction; Denison Mines (USA) Corp.; *Blanding, Utah.* Engineer of record for the design, permitting, and construction of the Cell 4A surface impoundment, which includes approximately 42 acres of lined area for the evaporation of very low pH process liquids and disposal of mill tailings. Geosyntec prepared ALR, stability, liner system design, leak detection system design, and slimes drain design calculations. Design report, CQA Plan, Technical Specifications, design analyses, and design drawings were prepared and submitted to the UDEQ for approval. Geosyntec is also providing construction quality assurance and construction management services during construction of the surface impoundment.

Geotechnical Infrastructure/Foundation Engineering

Secondary Containment System Design, Watkins Manufacturing, *El Cajon, California.* This project involved the design of a concrete secondary containment system for two 3,000 gallon steel tanks holding epoxy resin. GeoSyntec performed an environmental baseline survey of the soil and groundwater underlying the proposed secondary containment system, along with geotechnical subsurface exploration and associated testing. As the Project Manager, Mr. Corcoran was responsible for interfacing and communicating with the client, staffing, invoicing the client, and budgeting and scheduling field and design activities.

Foundation System Design, JLG Industries, *McConellsburg, Pennsylvania.* Responsible for developing several recommendation reports for the construction of four new structures. As Geotechnical Engineer, Mr. Corcoran was responsible for proposals, client communication, hiring of subcontractors for subsurface investigation, oversight of subcontractors, design analyses, economic impact analyses, and foundation recommendation reports. Key design considerations included settlement analyses, bearing capacity, shallow and deep foundation design, and economic impacts of different design approaches.

Geosyntec consultants

Foundation System Design, US Army Corps of Engineers, *Dover, Delaware.* As Design Engineer, Mr. Corcoran was responsible for design analyses including settlement, bearing capacity, and auger-cast pile foundation design for a deep foundation for two 10,000 bbl fuel storage tanks and shallow foundations for ancillary structures associated with the fuel storage tanks.

PATENTS

United States Patent No. US 6,706,096 B2 – "Method and System for Protecting Buildings from Subsurface Gases," dated 16 March 2004

PROFESSIONAL HISTORY

Geosyntec Consultants, 1997-Present
Roy F. Weston, Inc., 1994-1997
Golder Construction Services, 1994
NTH Consultants, Ltd., 1993
Drexel University, 1992-1994
Gundle Lining Systems, 1992
Golder Construction Services, 1989-1991

AFFILIATIONS

American Society for Testing and Materials, Committee D35 on Geosynthetics

REPRESENTATIVE PUBLICATIONS

09-1 Corcoran, G.T., Fitzwilliam, S.M., "Vapor Barriers for Deep Foundation Supported Structures," *Presentation and Proceedings, Contemporary Topics in Ground Modification, Problem Soils, and Geo-Support, 2009 International Foundation Congress and Equipment Expo,* Orlando, Florida.

02-1 Kavazanjian, E., Corcoran, G., "Combined Leachate Collection/Operations Layer for Side Slopes," *Presentation and Proceedings, WasteCon 2002*, Long Beach, California.

02-2 Corcoran, G., Leverenz, C., Mikolaitis, J., Kavazanjian, E., "Combined Leachate Collection and Operations Layer for Side Slope Liner Systems," Presentation and Proceedings, Arizona Hydrological Society 2002 Scientific Landfill Symposium, Tucson, Arizona.

02-3 Narejo, D., Corcoran, G., "Geomembrane Protection, Design Manual," GSE Lining Technology, Inc., Houston, Texas.

02-4 Narejo, D., Corcoran, G., Zunker, R., "An Evaluation of Geosynthetic Clay Liners to Minimize Geomembrane Leakage Caused by Protrusions in Subgrades and Compacted Clay Liners," *Proceedings, International Symposium on Clay Geosynthetic Barriers*, Nuremberg, Germany.

01-1 Kavazanjian, E., Hendron, D., Corcoran, G., "Strength and Stability of Bioreactor Landfills," *Proceedings, SWANA's 6th Annual Landfill Symposium*, San Diego, California.

00-1 Sanglerat, T.R., Corcoran, G.T., Riotte, D.W., "Engineering Solutions to Subsurface Gas Control for Brownfield Redevelopment," Presented to Southern California Association of Governments, Los Angeles, California.

00-2 Corcoran, G.T., Riotte, D.W., Sanglerat, T.R., "Gas Control System Experience," Presented to Blue Ribbon Citizens' Oversight Committee and Augmented Facilities Committee (Los Angeles School Board Public Meeting), Los Angeles, California.

00-3 Riotte, D.W., Corcoran, G.T., Sanglerat, T.R., "Design and Construction of Subsurface Gas Control System for Buildings," Presented to Los Angeles Department of Toxic Substances Control, Los Angeles, California.

95-1 Corcoran, G.T. and J.A. McKelvey, "Stability of Soil Layers on Compound Geosynthetic Slopes," *Waste Tech '95*, New Orleans, Louisiana.

94-1 Corcoran, G.T., Cheng, S.C. and A. Speer, "High Normal Stress Compression of Geosynthetic Lining Systems," *Proceedings of the 5th International Conference on Geotextiles, Geomembranes and Related Products*, IGS, Singapore.

94-2 Corcoran, G.T., Cheng, S.C., Miller, C., and Y. Lee, "The Use of a Spray Elastomer for Landfill Cover Liner Applications," *Proceedings of the 5th International Conference on Geotextiles, Geomembranes and Related Products*, IGS, Singapore.

Geosyntec consultants

SCOTT M. GRAVES, P.E.

landfill design and permitting
waste site remediation
construction management and quality assurance

EDUCATION

M.S., Civil Engineering (geotechnical emphasis), University of Texas at Austin, 1993
B.S., Civil Engineering, Iowa State University, 1991

REGISTRATIONS AND CERTIFICATIONS

Alabama P.E. Number 23929
Arkansas P.E. Number 9769
Florida P.E. Number 71061
Georgia P.E. Number 23730
Idaho P.E. Number 11472
Iowa P.E. Number 18639
Kentucky P.E. Number 2127
Louisiana P.E. Number 31181
Mississippi P.E. Number 14503
Ohio P.E. Number E-68434
Oklahoma P.E. Number 19710
Tennessee P.E. (inactive) Number 106713
Texas P.E. Number 86557

OSHA 29 CFR 1910.120(e) 40-Hour HAZWOPER Training Course
OSHA 29 CFR 1910.120(e) 8-Hour HAZWOPER Supervisor Training Course
Certified, Nuclear Moisture/Density Gauge Operation and Transportation
Certified, American Red Cross CPR and First Aid/Safety

CAREER SUMMARY

Scott Graves, P.E. has experience spanning two decades in geotechnical, environmental, and water resources engineering. A licensed professional engineer in twelve states, Mr. Graves holds Bachelors and Masters degrees in Civil Engineering. He specializes in landfill design and permitting, waste site remediation, and construction management/construction quality assurance (CM/CQA) for public and private clients in the waste management, electric utility, and petrochemical industries, as well as redevelopment companies and PRP groups.

He has been involved in the permitting or design of over twenty major landfills and surface impoundments throughout the U.S. His technical specialties include slope stability evaluations, civil layout/site grading, consolidation/settlement analyses, landfill gas extraction system layout and analysis, retaining wall design, leachate generation studies and collection system design, roadway design/layout, and hydrology/hydraulics design. His CM/CQA experience at over a

dozen facilities ranges from construction of landfill and impoundment liners and caps, gas collection and control system installation, earthwork, pile driving, clay liner test pad programs, geosynthetics installation, retaining walls, waste regrading, asphalt and concrete paving, and bridge construction.

Mr. Graves has conducted site geotechnical investigations, coordinated land use studies, and has managed hydrogeology investigations. He has also prepared solid and hazardous waste permit applications for landfill expansions, site development plans and site operating plans, zoning permits, master planning of phased development, and other related design calculation packages. In many cases he was the engineer-of-record for these applications. He is experienced in regulatory agency meetings and negotiations, and has applied this expertise to assist many clients with permitting issues. He has given numerous presentations to regulatory agencies and public committees on behalf of his clients. He has provided litigation support and expert testimony in related matters.

Landfill Design and Permitting

- ***Lone Mountain Facility, Landfill Cell 15, Lateral and Vertical Expansion,*** **Clean Harbors Environmental Services, Inc.** *Waynoka, Oklahoma.* Engineer-of-record and lead designer/project manager for a Class 3 Permit Modification application for lateral and vertical expansion of a triple-lined RCRA Subtitle C hazardous waste landfill. Developed conceptual layout options and evaluated feasibility. Prepared a geotechnical site investigation work plan and oversaw the site subsurface investigation. Prepared the permit modification package (Engineering Report, Drawings, and various calculation packages for design and analysis of landfill features, including the RCRA Subtitle C-equivalent liner system and final cover system).

- ***Deer Park Facility, Class 3 Permit Modification,*** **Clean Harbors Environmental Services, Inc.,** *La Porte, Texas.* Engineer-of-record and project manager for a Class 3 permit modification to a RCRA Subtitle C-equivalent double-lined industrial and hazardous waste landfill. Initially, he performed technical peer review of the landfill layout, followed by performing landfill design evaluations and calculations. Prepared overall engineering report for facility design and prepared calculation packages for surface water management, geotechnical analyses (slope stability, settlement, uplift), and leachate management system. The previous landfill design involved excessive and highly expensive excavation followed by construction of a below-grade landfill with a 13-ft thick compacted clay liner. The Class 3 permit modification raised the base grades, reduced the compacted clay liner to 3-ft thick, and raised the final cover grades to result in no loss of waste disposal volume. This modification will significantly lower construction and operating costs at the facility, and has been approved by TCEQ after very minimal comments.

- ***Ecological Services Site, Cell 3, Ecological Services, Inc.,*** *East Palestine, Ohio.* Design and field engineer for closure of a surface impoundment containing solidified hazardous pickle-liquor and sludge waste from the steel manufacturing industry. Coordinated several phases of field investigation and a laboratory testing program to characterize the extent and properties of the highly-compressible sludge material in the cell. Performed detailed consolidation and settlement modeling for multiple loading scenarios, allowing optimal design of a final cover capable of withstanding large settlements. Prepared design drawings, calculations, and technical specifications for an amended closure plan of the RCRA Subtitle C cap. Served as construction manager for the final capping project, which included implementation of a test pad program using the two-stage borehole technique (i.e., "Boutwell" testing) of measuring *in-situ* hydraulic conductivity. Coordinated a long-term settlement monitoring program to compare predicted vs. actual settlements and assess overall cap performance. The Amended Closure Plan was approved by the Ohio EPA, and cap construction was completed on time and below budget.

- ***Covel Gardens Landfill, Lateral and Vertical Expansion, Waste Management of Texas, Inc.,*** *San Antonio, Texas.* Engineer-of-record and lead designer/project manager for a major permit amendment application for lateral and vertical expansion of an existing Subtitle D municipal solid waste (MSW) and Class 1 industrial waste landfill facility and liquids stabilization processing. Performed conceptual design layout of several design scenarios, and then helped the owner assess the cost-benefit of the scenarios and select a design scenario that optimized use of the site within its boundaries and buffer zones. Conducted siting studies to evaluate the suitability of the disposal facility with the surroundings (traffic analyses and highway capacity evaluations, airport proximity studies, evaluation of floodplains, buffers, seismic impact, unstable areas, etc.). Prepared soil boring plan and directed a site subsurface investigation (geotechnical and hydrogeology) of the expansion area, followed by preparation of the solid waste facility design and permit application documents (Parts I through IV of the Texas Commission on Environmental Quality (TCEQ) permit amendment application). Also prepared several permit modifications over time that improved the constructability and cost-effectiveness of the permitted design, including changes to the base grading layout design, liner components, engineering details, and Soil and Liner Quality Control Plan (SLQCP). Prepared several construction drawing packages and contract documents (specifications, terms and conditions, bid forms, etc.) for liner system, final cover system, and leachate evaporation pond construction. The lateral and vertical expansion application was approved by TCEQ and added over 89 million cubic yards of waste disposal capacity (a 160% increase) to the second largest landfill in Texas.

- ***Mesquite Creek Landfill, Lateral Expansion*, Waste Management of Texas, Inc.,** *New Braunfels, Texas.* Engineer-of-record and lead designer/project manager for a major permit amendment application for lateral expansion of an existing Subtitle D municipal solid waste landfill facility. Evaluated conceptual design scenarios and helped client select the option that provided favorable economics and overall permitting and construction feasibility. Conducted land use studies, including transportation study and aviation-related approvals. Prepared soil boring plan (approved by TCEQ) and managed a site subsurface investigation (geotechnical and hydrogeology) of the expansion area. Prepared solid waste facility design and permit application documents (Parts I through IV permit amendment application), serving as the lead engineer-of-record. The permit amendment application was contested by opposing parties, and Mr. Graves participated extensively in the Contested Case Hearing before an Administrative Law Judge and provided expert testimony throughout the case. The judge recommended approval of the permit, and the TCEQ Commissioners approved the permit amendment application, which more than tripled the permitted waste disposal volume of the facility. The expansion area design features a Subtitle D composite liner, state of the art leachate collection system, and innovative alternative evapotranspiration (ET) final cover.

- ***Outer Loop Recycling and Disposal Facility, Lateral and Vertical Expansion, Waste Management of Kentucky, LLC,*** *Louisville, Kentucky.* Engineer-of-record and lead designer/project manager for a complex lateral expansion project at an existing contained MSW landfill facility in northern Kentucky. Directed a subsurface investigation, followed by design of the site layout plan and engineering analyses for settlement, slope stability, surface-water management, leachate management, etc. Also prepared several permit applications to local agencies (e.g., zoning permits, site development, floodplain development, etc.), and gave several presentations during agency meetings. The project was complicated by restrictions that severely limit the geometry of the expansion, requires several variance requests to siting criteria, and has multiple local, state, and federal agencies involved in permitting. Met with the Kentucky Division of Waste Management (KDWM) and other agencies on numerous occasions throughout the multi-year project to facilitate their understanding, review submittals, address questions, etc. The solid waste permit application for the largest contained landfill in Kentucky was approved by KDWM. After expansion approval, continued to serve as design engineer by preparing construction drawings, technical specifications, and bid documents for the first phase of lateral expansion liner construction.

- ***Rare Earth Material Long-Term Storage Facility Decommissioning and Disposal,*** *Ipoh, Malaysia*. Mr. Graves worked in-country in Malaysia for Geosyntec's Malaysian subsidiary, GSM Consultancy, on a project involving the decommissioning of a storage facility containing 90,000 drums containing radioactive filter cake impacted with thorium which resulted from the processing of xenotime and monanzite ore. Mr.

Graves primary role was assisting with the tender process of subcontractor evaluation and negotiation to help select a construction firm to implement decommissioning plan and construct an on-site disposal facility. Mr. Graves also participated in several meetings with Malaysian government regulatory officials to discuss their role in project inspections a develop construction quality assurance and related oversight plans.

- ***Comal County Landfill, Waste Management of Texas, Inc., Transfer Station Registration Modification and TxDOT Driveway Permit****, New Braunfels, Texas.* Engineer-of-record and lead designer/project manager for minor registration modification to change the driveway location for a proposed solid waste transfer station. The work also involved re-designing the site grading plan and internal roadway layout to better accommodate traffic flow and vehicle capabilities. Prepared a TxDOT driveway permit application, which considered impact of expected facility traffic on the safety and traffic flow characteristics of the adjacent farm-to-market road.

- ***Warner Hill Landfill, Retaining Wall and Capping Remedy, Warner Hill Development Company, Inc.,*** *Cleveland, Ohio.* Designer and full-time resident engineer/construction manager. Responsible for planning and conceptual layout/economic analyses, slope stability, infiltration/water-balance evaluation, riverbank erosion protection, surface-water drainage, pavement design, and site grading and drainage. Prepared a permit application report and drawings, construction drawings, technical specifications, and bid documents. The project included construction of a crib retaining wall with approximately 65,000 ft^2 of face area, regrading of approximately 250,000 yd^3 of solid waste, and installation of a low-permeability compacted soil cover over the site. As the resident engineer, coordinated CQA activities, monitored construction, directed critical contractor activities, conducted project meetings, met with regulatory and government officials, and evaluated design changes. Construction of the remedy was completed on-time and below budget. The project rehabilitated a poorly performing landfill and improved environmental quality of the surroundings of this urban-area landfill. Mr. Graves has continued his involvement in this site by conducting annual post-closure site inspections each year from 1997 to the present. He has helped implement minor cover and retaining wall repairs as needed to address the gradual weathering of the site.

- ***Live Oak Landfill, Vertical Expansion, Waste Management of Georgia, Inc.,*** *Atlanta, Georgia*. Project manager and lead designer for a vertical expansion to increase the capacity of an existing 130-acre municipal solid waste landfill. Prepared a "Design and Operational (D&O) Plan" package that was submitted to and subsequently approved by the state regulatory agency. The design featured an innovative mechanically-stabilized earth (MSE) berm around much of the landfill perimeter to maximize airspace while maintaining the site buffers. The resulting design layout increased the capacity by

approximately 5 million tons, which was nearly double the increase of a previous design performed by another company prior to GeoSyntec's involvement with the project.

- ***Confidential Site and Client, Site Suitability Study,*** *Virginia*. Project manager and technical lead for the project, which involved identifying, evaluating, and comparing potential sites for locating a coal combustion byproduct disposal facility for a utility company. The sites are located in a complex geologic setting, and required field reconnaissance, supplemented by evaluation of published maps and studies, to identify sites that are viable from a design/permitting standpoint. Developed conceptual landfill design layouts of the facility for several sites with good potential, and prepared cost/benefit analyses to identify the economic issues for each site. This study gives the client the necessary information to evaluate the economic feasibility of each site and select a preferred location for future landfill development.

Waste Site Remediation

- ***Shell Wood River Refinery Site 15 Solid Waste Disposal Basin, Equilon Enterprises, LLC,*** *Roxana, Illinois.* Lead Designer for solidification and closure of a 12-acre petroleum-sludge impoundment at an oil refinery. Conducted an extensive field investigation to characterize the extent and *in-situ* strength of the sludge, and devised a sampling technique for obtaining specimens of very soft sludge from a pontoon boat. Directed a bench-scale testing program to characterize the sludge and evaluate potential solidification admixtures. Used the results of the field program and laboratory study to develop a cover grading configuration and lightweight RCRA Subtitle C-equivalent cap design for the impoundment, and directed a team of engineers and CADD designers to prepare design drawings and engineering calculations. A Closure Plan (design report, a drawing package, and specifications) was submitted to the Illinois Environmental Protection Agency (IEPA) for review. The permit application was approved by IEPA with no technical/engineering related comments.

- ***Yeoman Creek Landfill Superfund Project, Yeoman Creek Remediation Group,*** *Waukegan, Illinois.* Lead Designer for 30% through 95% Pre-Final Remedial Design CERCLA capping and remediation project. Conducted a field subsurface investigation to obtain supplemental information (e.g., geotechnical properties of foundation soils, extent of waste, etc.) for use in optimizing the design. Completed remedial design package of drawings, calculations, technical specifications, and construction quality assurance (CQA) plan.

- ***Wingate Road Landfill Superfund Project, Wingate PRP Group,*** *Ft. Lauderdale, Florida.* Design Engineer for CERCLA project site demolition and landfill capping remedial design. Performed site investigations to collect supplemental information, and supervised the preliminary civil/layout and geotechnical design analyses. Completed a Preliminary (30%) Design and prepared a Design/Build Bid Package for procurement of a design/build team, which included a work plan, drawings, specifications, and a quality assurance/quality control (QA/QC) plan. This project was the first design/build CERCLA project conducted in USEPA Region IV.

Construction Management and Quality Assurance

- ***Lone Mountain Landfill, Phase 2A, Subcell 4 Liner System, Clean Harbors Environmental Services, Inc.,*** *Waynoka, Oklahoma.* 165,000 ft^2 (3.8 acres) of triple-liner system at a RCRA Subtitle C hazardous waste landfill. 3-ft thick compacted clay, 2 layers of 60-mil HDPE geomembrane, 1 layer of 80-mil HDPE geomembrane, geonets and geotextiles, leak detection and leachate collection layers/corridors/sumps, protective cover. Position – CQA Certifying Engineer and Project Manager.

- ***Mesquite Creek Landfill, Unit2, Phase I Liner System, Waste Management of Texas, Inc.,*** *New Braunfels, Texas.* 553,200 (12.7 acres) of single composite liner system construction at the first phase of a new landfill unit. 2-ft thick compacted soil liner, 6-mil textured HDPE geomembrane, geocomposite drainage layer, leachate collection corridors, chimney drain, and sump. Leachate collection piping, riser pipes, and dual-contained leachate forcemain with cleanout manhole and air-release manhole. Position – Professional of Record (CQA Engineer) and Project Manager.

- ***Mesquite Creek Landfill, Unit 1, Phases I and II Final Cover System, Waste Management of Texas, Inc.,*** *New Braunfels, Texas.* 348,000 (8 acres) of soil-only final cover system composed of low permeability soil and topsoil. Work also included construction of drainage benches, downchutes, and erosion controls. Position – Professional of Record (CQA Engineer) and Project Manager.

- ***Mesquite Creek Landfill, Unit 2 Perimeter Features, Waste Management of Texas, Inc.,*** *New Braunfels, Texas.* Earthwork and extensive road construction and concrete paving for a new unit at this facility. Also included installation of three scales, a new office building, and storm water pond construction. Position – Professional-of-Record (CQA Engineer) and Project Manager.

- ***Lacy Lakeview Recycling and Disposal Facility, Phase III, Cell 3-4 Liner System, Waste Management of Texas, Inc.,*** *Waco, Texas.* 291,900 ft^2 (6.7 acres) of single composite liner at an MSW landfill. Underdrain (groundwater dewatering system), 2-ft

thick compacted clay, 60-mil HDPE geomembrane, geocomposite, geotextile, leachate collection corridors, protective soil. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Covel Gardens Recycling, Processing, and Disposal Facility, Phase VI Central Liner System, Waste Management of Texas, Inc.,*** *San Antonio, Texas.* 448,700 ft^2 (10.3 acres) of single composite liner at an MSW landfill. 2 to 3-ft thick compacted clay, 60-mil HDPE geomembrane, geocomposite, geotextile, leachate collection corridors, protective soil. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Covel Gardens Recycling, Processing, and Disposal Facility, Phase III Final Cap, Waste Management of Texas, Inc.,*** *San Antonio, Texas.* 130,680 ft^2 (3 acres) of soil-only (Subtitle D equivalent) final cover system. 3.5-ft thick compacted clay cap, 0.5-ft thick topsoil, drainage berms and downchutes. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Williamson County Landfill, Sector 2B Liner System, Waste Management of Texas, Inc.,*** *Hutto, Texas.* 371,000 ft^2 (8.5 acres) of single composite liner at an MSW landfill. 2-ft thick compacted clay, 60-mil HDPE geomembrane, geocomposite, geotextile, leachate collection corridors, sumps, piping, protective soil. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Williamson County Landfill, Phase I Final Cap, Waste Management of Texas, Inc.,*** *Hutto, Texas.* 130,680 ft^2 (3 acres) of soil-only (Subtitle D equivalent) final cover system. 3-ft thick compacted clay cap, 0.5-ft thick topsoil, drainage berms and downchutes. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Covel Gardens Recycling, Processing, and Disposal Facility, Phase V Central Liner System, Waste Management of Texas, Inc.,*** *San Antonio, Texas.* 326,700 ft^2 (7.5 acres) of single composite liner at MSW landfill. 2 to 3-ft thick compacted clay, 60-mil HDPE geomembrane, geocomposite, geotextile, leachate collection corridors, protective soil. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Covel Gardens Recycling, Processing, and Disposal Facility, Phase I Final Cap, Waste Management of Texas, Inc.,*** *San Antonio, Texas.* 261,360 ft^2 (6 acres) of soil-only (Subtitle D equivalent) final cover system. 3.5-ft thick compacted clay cap, 0.5-ft thick topsoil, drainage berms and downchutes. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Covel Gardens Recycling, Processing, and Disposal Facility, Leachate Evaporation Pond C Liner System, Waste Management of Texas, Inc.,*** *San Antonio, Texas.* 143,748

ft^2 (3.3 acres) of double liner. Prepared subgrade, geosynthetic clay liner (GCL), two 60-mil HDPE geomembranes. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Covel Gardens Recycling, Processing, and Disposal Facility, Phase IV Liner System Repair, Waste Management of Texas, Inc.,*** *San Antonio, Texas.* 32,670 ft^2 (0.75 acres) of single composite liner at MSW landfill to repair slope stability problem. In-situ clay, GCL, 60-mil HDPE geomembrane, geotextile drainage layer, protective soil. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Warner Hill Landfill, Final Cover System Repairs, Warner Hill Development Company, Inc.,*** *Cleveland, Ohio.* Approximately 1-acre of soil-only final cover system at closed MSW landfill. Repaired erosion, revetment mat downchute washouts, and other drainage features. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Tontitown Landfill, Leachate System Investigation and Liner System Repair, Waste Management, Inc.,*** *Tontitown, Arkansas.* Investigation of leachate collection piping integrity and repair of single-composite liner system. Video reconnaissance and high pressure water jetting of piping. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Yell County Landfill, Liner System, Waste Management, Inc.,*** *Russellville, Arkansas.* 348,480 ft^2 (8 acres) of single composite liner at an MSW landfill. 2 ft thick compacted clay, 60-mil HDPE geomembrane, geocomposite, geotextile, leachate collection corridors, protective soil. Position – Professional-of-Record (CQA Certifying Engineer) and Project Manager.

- ***Model Fill Landfill, Liner System, BFI Waste Systems,*** *Little Rock, Arkansas.* 239,600 ft^2 (5.5 acres) of single composite liner at an MSW landfill. 2-ft thick compacted clay, 60-mil HDPE geomembrane, geocomposite, geotextile, leachate collection corridors, protective soil. Position – Assistant Project Manager.

- ***Ecological Services Site, Cell 3, Ecological Services, Inc.,*** *East Palestine, Ohio*. 522,700 ft^2 (12 acres) of single composite final cover system at a RCRA Subtitle C Impoundment Closure. Two clay test pads with two-stage borehole in-situ testing. 2-ft thick compacted clay, 40-mil PE geomembrane, geocomposite, pipe penetrations, protective soil, topsoil, drainage features. Position – Project Manager and Construction Manager.

- ***Warner Hill Landfill, Maintenance Plan for Retaining Wall and Capping, Warner Hill Development Company, Inc.,*** *Cleveland, Ohio.* 2,178,000 ft^2 (50 acres) of soil-only final

cover system at a closed MSW landfill. Waste regrading, 3,300-ft long by 22-ft tall retaining wall construction, 2-ft thick compacted clay, 0.5-ft thick topsoil, drainage benches, downchutes, gas system penetrations. Position – Resident Engineer and CQA Site Manager.

- ***Oak Ridge Landfill, Liner System, Chambers Development Company,*** *Dorchester, South Carolina.* 348,500 ft^2 (8 acres) of single-composite liner system at an MSW landfill. Clay test pad. 2-ft thick compacted clay, 60-mil geomembrane, geocomposite, leachate collection trench with piping, sump, protective sand, topsoil. Position – CQA Project Manager.

- ***Maplewood Recycling and Disposal Facility, Liner System, Chambers Development Company,*** *Amelia County, Virginia.* 431,400 ft^2 (12.2 acres) of double composite liner system at an MSW landfill. 2-ft thick compacted clay, 60-mil geomembranes, geocomposite, leachate collection trench with piping, sump, protective sand, topsoil. Position – CQA Project Manager.

- ***Highway and Bridge Construction Projects,*** *Iowa.* Mr. Graves was also employed for four consecutive summers by the Iowa Department of Transportation, during which time he was involved in a variety of transportation and materials engineering projects, including conceptual and final highway design; earthwork, paving, and bridge CQA; and research on the field performance of experimental highway materials. Through this experience he became well versed in many heavy/highway construction methods and gained familiarity in dealing with contractors and making sound field decisions.

PROFESSIONAL EXPERIENCE

Geosyntec Consultants, Austin, Texas, 2000 – Present.
Geosyntec Consultants, Atlanta, Georgia. 1993 – 2000.
University of Texas at Austin, Austin, Texas, Graduate Research Assistant, 1991 – 1993.
Iowa Department of Transportation, Ames, Iowa, 1988 – 1991.

AFFILIATIONS

Member, American Society of Civil Engineers (ASCE) and ASCE Geo-Institute
Member, North American Geosynthetics Society (NAGS)
Member, International Geosynthetics Society (IGS)

PUBLICATIONS AND INVITED PRESENTATIONS

99-01 Graves, S.M., "Geotechnical Considerations for Landfill Site Remediation," ASCE Atlanta Chapter Monthly Technical Seminar, ASCE, Atlanta, Georgia, April 1999.

98-02 Graves, S.M., Luettich, S.M., Duncan, P., and Kern, T.J., "Case Study - Slope Stabilization and Flood Protection Remedy of the 50-Acre Warner Hill Landfill," *Proceedings - Waste Tech '98 Conference*, February 1998.

98-01 Graves, S.M., "Case Study - Slope Stabilization and Flood Protection Remedy of the 50-Acre Warner Hill Landfill," Waste Tech '98 Conference Technical Session, San Antonio, Texas, 2-4 February 1998.

93-01 Graves, S.M., "Enhanced Soil Vapor Extraction with Soil Heating," M.S. Thesis, The University of Texas at Austin, Austin, Texas, May 1993.